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History, Trust and Mistrust: Lessons From Radioactive Waste Disposal Megaprojects

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7th IPMA Research Conference

Zagreb, Croatia, Sept 4-7, 2019

Trust in Major and Mega Projects

7th IPMA Research Conference

Edited by Ding Ronggui, Ph.D.

Zagreb, Croatia, Sept 4-7, 2019

Trust in Major and Mega Projects

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Foreword

The IPMA Research Conference was founded in 2013 as a Think Tank, aiming to bring researchers, experts, scholars and practitioners in project management together who share a common passion for their disciplines. The distinctive feature of this conference is the intense dialogue between practitioners and academics, which can neither be found at scientific or professional conferences. The special spirit of the IPMA Research Conferences can be particularly felt in the World Café sessions where the participants can gain new insight for today's challenges in project management.

The theme of the 7th IPMA Research Conference 2019 is ***Trust in Major and Mega Projects***. The paramount epistemological question concerning trust is who and what to trust. Trust enhances cooperation and is often viewed as a foundation for social order and an important social resource that facilitates collaboration and enables coordinated social interaction. All the projects have some extent of innovation, which means leaving some margins or black boxes in the utmost elaborately designed and strictly executed management systems, especially for mega projects. The margins or black boxes can only be made clear with project stakeholders' cognition, competence, attitude and so on, in which trust plays an extremely important role. In this connection, projects can be viewed as temporary organizational frameworks that deserve special attention, and one of the key factors for successful mega projects are various types of trusts deeply embedded in the project stakeholder social networks. In particular: interpersonal, intra-firm, and inter-firm trust becomes intertwined in intra-project trust. This is where psychology, sociology, and economics are needed to understand all the interactions involved.

Trust cannot be independent of culturally related concerns, and a challenge for managing megaprojects is to deal with the conflicts among the diverse opinions and behaviors closely generated from the stakeholders' cultural backgrounds. The 24 papers in the proceedings are provided by the authors from 16 countries in Europe, North America, Asia, Australia and Africa, such as Algeria, Australia, Canada, China, Iran, and Germany. Their multidimensional perspectives on trust are extremely valuable to readers' reference.

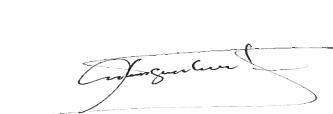
It's hard to expect precisely defined mathematical formulas to represent the causes and effects of trust in major and mega projects. That is why the most frequently used research method by the authors in the proceedings is empirical research, with 13 papers taking about 55% of the papers published in the proceedings. Empirical researches will be able to help readers understand

how trust plays different roles in managing major and mega projects. There are 6 papers based on literature analysis, which can give the readers a view of the current academic or research world about trust in major and megaproject management. However, if the readers wish to find how the deductive mathematical approach could be used to represent and solve trust-related problems, there are still 5 papers that will give them examples about it. Simulation is an exciting and effective research approach for project management, which there are some examples in the proceedings for the readers too.

The proceedings show the various aspects of trust in major and megaprojects: there are 5 papers in the category ***Stakeholder Management Influence on Trust***, 10 papers in the category ***Trust and Project Performance***, 4 papers in the category ***Trust as Leaver of Success in Projects***, and 5 papers in the category ***Drivers and Barriers in Building Trust in Projects***. The categories are not strictly separated and some papers can be put in different categories. However, the categories will make it easy for the readers to find the issues and the related papers they are most interested in.

The 7th IPMA Research Conference 2019 went in parallel with 14th International Conference on Organization, Technology, and Management in Construction. Both conferences were served by the same International Scientific Committee, the paper reviewers were from IPMA Global Research Group 2019-2021 and the International Scientific Committee of the conferences. All 24 papers published in the proceedings have gone through a double-blind review process, and the criteria for reviewing the papers are *Relevance for IPMA Research Conference, Importance of Topic and Results, Organization and Presentation, Thematic Relevance, Quality of Established Context to the Published Literature, Quality of Underlying Theory/Methodology, Contribution to Theory/Practice, and English Language and Writing Quality*. All of the authors received revision feedbacks and comments from 2 or 3 reviewers, and most of them modified the submissions before they were accepted. The papers published in the proceedings are with signed consent for publishing from the authors.

We would like to take this forward to thank all authors for contributing with their papers to the success of the Research Conference, all reviewers for their constructive feedback to the papers, the conference stream facilitators for their professional moderation of the research tracks. And we would like to give special appreciation to Professor Mladen Vukomanović, Ms. Ewa Bednarczyk, Ms. Magdalena Gawlak, and Professor Zvonko Sigmund for their ongoing and professional support. Especially, we do appreciate Professor Constanta Bodea, the IPMA vice president in charge of IPMA research, for her great support for the conference. And thanks to Croatian Association for Construction Management, Faculty of Civil Engineering of the University of Zagreb, and Croatian Association of Project Management for hosting the 7th IPMA Research Conference, and finally IPMA for publishing the conference papers.



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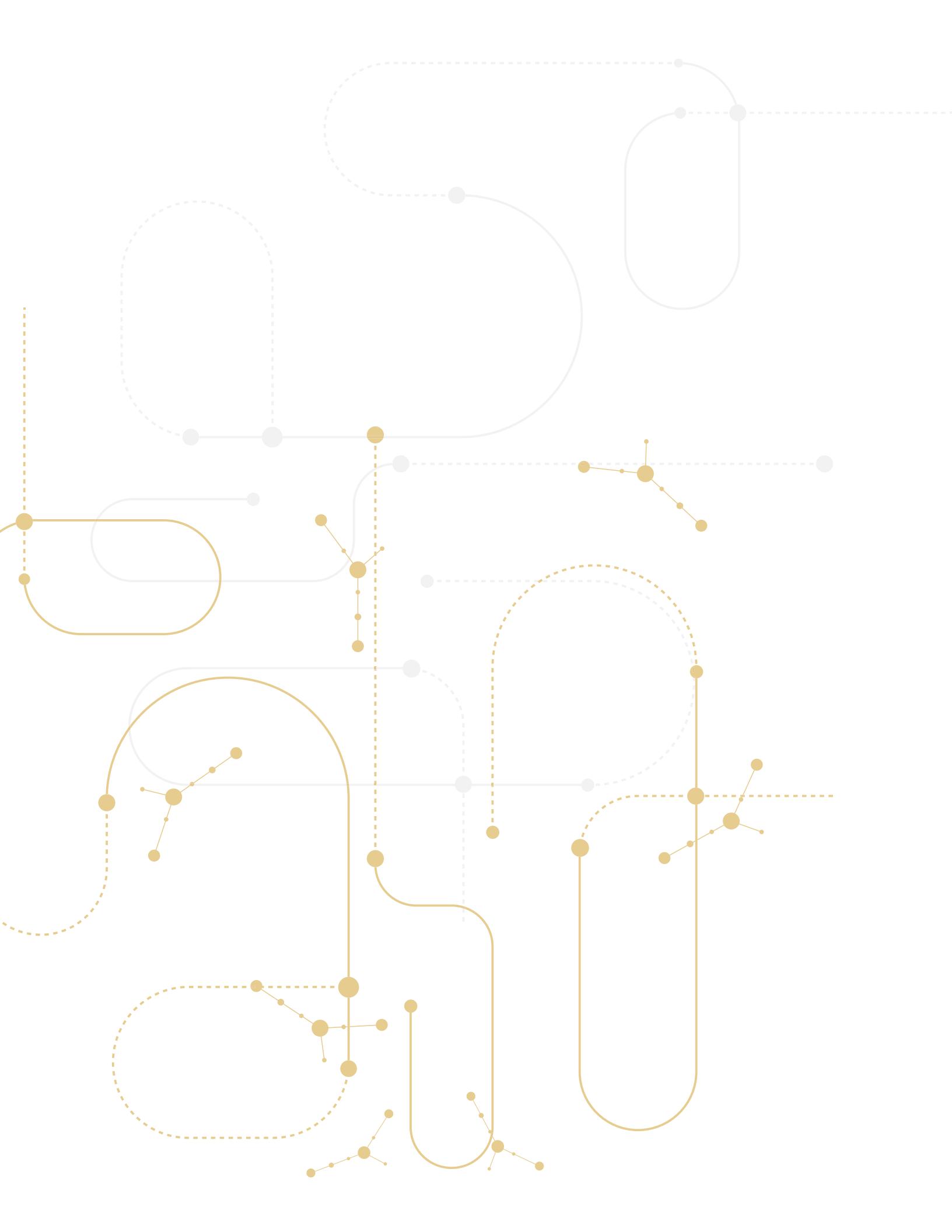
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I.

Stakeholder Management Influence on Trust



Trust Factors in Megaprojects in the high Inflation Countries: Case Studies

ABSTRACT

Undoubtedly, Megaprojects have special characteristics rather than routine projects. The complexity is as outstanding megaprojects characteristic that is related to trust but its opposite. There are several trust types, however we focused on the humanities trust factors which is related to social complexity. Identifying the trust factors in the various projects are the complicated problem because of their peculiarity, traits and characteristics especially in the megaprojects. The liaison between trust and stakeholder engagement management could help because they manage closely with each other. Stakeholder is included wide range from project team members to external stakeholders like suppliers, governmental agencies. The previous papers implied to internal stakeholder, but In this paper, we scrutinize the trust factors based on scientific references and interviewing with the key stakeholder (internal and external) in the two megaprojects. Those case studies were for the Iranian Mines and Mining Industries Development and Renovation, known as IMIDRO in the high inflation country. Hence, we created the questionnaires based upon combination of world-class standards and data were collected from walk of life. We gathered data through semi-structured interview and analyzed them via exploration method. Our method is depending upon Subject Matter Expert (SME) considerations which the consequences show the prioritized list of Key Trust Factors 1 (KTFs). We demonstrated this model for evaluating trust factors in the Iran, but, there is ability to expand to other megaprojects across the world. Our paper fully engaged that trust factors help to getting success in the megaprojects by letting to communication better.

Keywords: Megaprojects; Complexity; Key Trust Factors (KTFs)

INTRODUCTION

Middle East is the cradle of civilization in the world. It had been the geopolitical zone in the world that always has been impacted on particular crisis. However, middle east origins the initiation of large projects from antiquity and there are several huge projects across Middle East zone like Persepolis, ancient Greek Palace, round city of Baghdad. Besides, the Middle East have a lot of natural resources, a region that includes of richest countries in the world with enormous resources of oil, gas and mineral stones (Billmeier and Massa, 2007) but they are in poverty, inequality and economic growth that is low in the Middle East (Adams and Jr. John, 2003). The low pace of development was controversial issue among Middle East countries, and we can clearly see fluctuations, instability and high inflation across these countries.

The inflation of countries are also differ for example, Iran, Sudan and Turkey experienced high-inflation rates. However, inflation figures seem to be less of a concern in high-income countries like Bahrain and Kuwait (BASHIR, 2003). Iran has an abundant natural resources especially the riches mineral resources. It possesses the second largest substantiated natural gas and forth largest oil reservoir in the world (EIA, 2014). There are no enough information from the megaprojects consequences in Iran, but from subject matter expert perspective the megaprojects usually initiate in the infrastructure because of the fact that Iran is developing countries and needs to forward movement in the future decades. The megaproject is so attractive subject in Iran and is knotted with economical circumstance. Nowadays, Iran has initiated the several megaprojects like the mining industries projects which can impact on the GDP 2 percent. Despite of the fact that 1% increase in natural resource production

results in a 0.47% decline in GDP (Ahmed, Shahbaz, 2016) But Too many projects proceed that should not have done (Morris and Hough, 1987) and these are wasteful and lead to misallocation of resources in both organization and society, because go ahead with project are based on misinformation more than on information (Rouse, Margaret, 2018). Regarding this issue, there are megaprojects which haven't viability to continuation. During last decade, the researchers discussed about the megaprojects definition. Approximately, there are the classic definition which is called Mega / Giga / Tera projects. Usually, they have five attributes: 1) high capital cost 2) long duration but program urgency 3) Technological and logically demanding 4) Requiring multidisciplinary inputs (for many organizations) 5) leading to virtual enterprise for execution (Hassan et al, 1999). Besides, the megaprojects have strongly relationship with complexity so that they mix together.

Complexity is number of different elements in a system, alone and possible relations among these elements (Simon, 1969). Meanwhile, the complexity must be managed to achieve the project success. The megaprojects characteristics are Size, Time, Cost, Schedule / Budget, Team Composition, Contract, Customer Support, Requirement, Political Implication, Communications, Stakeholder Management, Organizational change impact on, External Constraints, Risk, Integration, Technology, and IT complexity (Hass, 2009). However, The megaprojects have special trait among project management field which have to tailor based on circumstance of high inflation countries or the experts related megaprojects to problems (Tamed, Untamed) (Douglas and Wildavsky (1983), van de Graaf and Hoppe, 1996).

Complexity dimensions are such as task, social, culture. For task complexity by breaking down to functional department, to social complexity by trust and commitment and cultural by sense making (Grun, 2004). Obviously, the trust factors is akin to social complexity which can influence with each other.

It's worth mentioning that megaproject and complexity is combined with each other and both of them can impact on the trust factors and vice versa. After the years, the trust is added to megaproject and complexity which is directly related to social and interpersonal characteristics. Trust is the set of implicit variables can guarantee megaprojects success. Regarding the overarching view point, trust provides a

framework for ethical decision making and managerial accountability and defined roles (Zwikael, Smyrk, 2014). Trust intertwines with complexity but its counterpart. On the other hand, there is the strong correlation between trust and project success (Pinto et al., 2009)

Undoubtedly, the combination of trust, complexity and megaproject was the serious subject which can determine the megaprojects success factors. Generally, Previous studies imply to complexity factors, megaprojects characteristics and the role of internal stakeholders engagement in creating of trust, but in this research aims to collect and examine all trust factors as Key Trust Factors(KTF) based on exploration method from key stakeholders(internal and external) of two megaproject and suggest the list of trust factors which has tailored for high inflation countries especially Iran in the chaos situation.

The paper is taken into account all trust factors with regard to internal and external stakeholders. These factors are linked with megaproject characteristics.

This research relies upon the role of Subject Matter Expert (SME) and tries to elicitation of trust factors based on interview and questionnaires. Therefore, this research has high dependencies with interpersonal characteristics as well as environment factors.

METHOD

All things commence to lack of trust in the megaprojects with the unstable economic condition in the countries like Middle East zone countries. The combination of trust and complex factors such as war, sanction, revolution, political climate, and environmental issue and even though geopolitical condition especially for high inflation countries and impact on the megaprojects are the very interesting subject for key stakeholders because the trust comes from what factor. Almost, the previous researches discuss about trust which is pertinent to internal stakeholders. Furthermore, they don't concentrate on location or situations. Therefore, there is research gap among trust, complexity and megaprojects relationship which could be reveal interrelationship with each other. Understanding of megaprojects factors turn on the light for the complexity factor as a major factor within megaproject. Moreover, the Introduction of complexity fac-

tors in the megaprojects help to recognition of trust factors. Due to the lack of information about megaprojects lead to that we selected two megaprojects and who are strongly involved to success. Our aims were elicited all key trust factors based on explanation method in semi-structure interview. About 10 key stakeholders had been selected who could make decision without permission from higher level. This method had a lot of problems because they had themselves style and usually run away from right format. The liaison of megaprojects and complexity have to consider because we extract trust factors from megaproject characteristics as well as stakeholders perspective especially in high inflation countries. For clarification, we explain the megaprojects characteristics which is described in the recent articles and then we review correlation between megaprojects and complexity which is spawned the expended list of trust factors in the megaprojects. The pattern recognition and deployment could be saliency of this method because this is the first time which is determined the trust factor in high crisis country in the megaprojects. For this purpose we will discuss about literature review and after that we foster the Key Trust Factor (KTF) list that we will test it.

WHAT YOU SHOULD KNOW ABOUT MEGAPROJECTS?

Mega / Giga / Tera projects are not only large / growing constantly larger, however are also being Megaprojects are spatially situated. Megaproject entail "creative destruction". It's broadly as projects which transform landscapes rapidly, intentionally and profoundly in very visible way. International construction firm, private and public wielding considerable power in support of megaproject especially in developing nations (Goldman, 2001).

It built in ever greater numbers, ever greater value more than 27 times of Giga. The mega comes from Greek word "Megas" and means great, large, vast, big, high, tall, mighty and important from scientific and technical measurement means " one million". From economic perspective the term "mega" means one million dollar / euro / pound project cost had escalated to the billions. The megaproject is a dramatic new forum of discourse (Froomkin, 2009) and costly overruns, the fraud and abuse the endless excuses (Obama, 2009). Nation maybe affected by a single megaproject failure like 2004 Olympic Games in Athens. The Better under-

standing of cases a better grasp of cure has followed from front-end management (William and Samset, 2010) and improve megaprojects management needs to rebuild minded individuals and groups. This is the tension point where convention meets reform, power balance change and new things are happening. Megaproject involves different culture, background, language (Shore and cross, 2005)

The Conventional megaproject is different from normal projects. Such as energy water, infrastructural, mining, supply chain, enterprise system, merge and acquisition. Those projects have lot of complexity and eye catching. Complexity also implies risk and uncertainty in terms of funding and construction (Frick, 2008). Megaprojects like: "Big Dig" central artery / tunnel in US, Kala Lumpur international Airport in Malaysia, Ultra Mega power Plant in India, GLONASS, a satellite navigation system in Russia, Olympic game in China, Burg Khalifa, The world's tallest building in Dubai. In the megaproject context, there are several theories which are strongly related to this context as following:

- **Iron Law of megaprojects:** over budget and benefit shortfalls, overtime, over gain, over run and one out of ten is on budget, time and benefit. Despite of many signals for failing outcomes, megaprojects are continue (Flybjerg, 2003).
- **Break-Fix-Model:** environment of inverted Darwinism (evolution), where the better projects on paper become worse/unfitness in implemented reality. Manager and planner don't know how to deliver, how don't have incentives tend to break sooner/ later. This is the genuine paradox, so called "megaprojects" paradox (Flybjerg, 2003). Therefore, the Megaprojects called "Vietnam": easy to begin, difficult and expensive to stop (Whitehouse, 2012).
- **Hirschman's Hiding Hand:** Indeed, some sort of invisible/ hidden hand that beneficially hides difficulties for us. The middle of constitution never to return because of the fact that it cannot be reversed irrespective of future events (Sunk Cost). In praise of folly/ create errors (Sawyer, 1952), the theory offers a framework to examine how ignorance for concerning future obstacle interest with rational choice to undertake a project. Iron Law of megaproject described above trumps hiding hand at high level of statistical significance and planning fallacy. However, Flyvbjerg who has opposite theory of hiding

hand. He said first, the Principle is not testable or proposition that could be examined by systematic empirical tests; and second, its implications have yet to be explored in relation to other social science principles, and in particular the causes.

- **Survival of the unfitness:** why the worse projects get built rather than best? And why are megaprojects so attractive?
 - » One: technological sublimes, pushing the boundaries for what technology can do such as building the tallest building, longest wind turbine, tallest aircraft / first anything.
 - » Two: political sublimes, rapture politicians get from building monument.

Megaprojects are manifest, garner attention and lend an air of pro-activeness.

 - » Three: economic sublimes, get lots many and jobs
 - » Four: aesthetic sublimes, appreciate good design get from building.
- **Illusion of control:** pitfall arises often due to the high degree of uncertainty which leads to an inherent difficulty in forecasting. The decision maker, knowingly / unintentionally, optimistically, misinterprets project facts and figurines which is called “managerial trap”. This behavior leads to the failure of megaprojects in cost overrun and benefit shortfalls.
- **Sunk cost effect:** The cost has been incurred and irrespective to future decision. Actually sunk cost effect is white lie to explains the behavior of reinvestment despite losses (Arkes and Ayton, 1999). Sunk cost effect is the tendency to keep alive an endeavor once a substantial investment has been made and cannot be reversed (Hutzel, 2000). A possible trigger of the sunk cost effect may occur on a psychological level.
- **Prospect theory:** It is providing a logical framework for explaining deviations from rational behavior as predicted by expected utility theory (Kahneman and Tversky, 1979). If the assumptive future seems to be under the references' point, losses will be greater than gains, concluding that the individual shows a tendency toward risk seeking behavior. Otherwise, they are risk averse (Kahneman and Tversky, 1979).

- **Self-justification theory:** It provides as explanation for escalating commitment of manager. The tendency of decision makers to stick with a failing course of action. It posits that decision makers unwilling to admit that their prior decisions and resource allocation were not mark (Brockner, 1992).

- **Moral hazard:** change behavior, maximize his own interest rather than benefit of collaboration, stop resource flow and reduce positive effect in investment (Elitzur and Gavious, 2008). Conversely, moral contract decreases the risk of moral hazard or other potential troubles (Cavusgil, 1998).

Megaprojects are inherently risky due to long planning horizons and complex interfaces (Flyvbjerg, 2006). It has often leaving leadership week and decision making are typically multi actors and stakeholders (Aaltonen and Kujala, 2002). Impedes learning from other projects-over commitment result in fail fast does not apply, fail slow does (Cantarelli et al, 2010). The megaprojects are large sum of money involved, project scope is ambition, change dramatically, high risk, stochastic so called “black swans”, complexity and unplanned event and contingency inadequate, unpredictable event with negative consequence, miss information lead to cost overrun, delays and benefit shortfalls.

EXPLANATION OF MEGAPROJECTS AND COMPLEXITY

Understanding of megaprojects characteristics help to recognize the inherent complexity which can clear the underlying reasons for megaprojects failure. Megaprojects are complex ventures and typically cost 1 billion US \$, take many years, multiple public and private stakeholders are transformational, impact millions of people (Flyvbjerg, 2014) such projects have “trait making”/ “privilege practical of development” (Hirschman, 1995). Of course, megaprojects are not program and it is large project (PMBOK, 2017). Types of megaprojects are such as 1) infrastructure 2) extraction [mining, oil] 3) Production [industrial tree plantation] 4) Consumption, massive tourist, malls (Paul K. Gellert and Barbara D. Lynch, 2003), they are pertinent to complexity, risk (Ardes, Ozturk, S. Cavusgil, 2013). Megaproject is inherently risky due to long planning horizons and complex interfaces (Flyvbjerg, 2006). Besides, Megaprojects are characterized

by complexity, uncertainty, ambiguity, dynamic interfaces, significant political for external influences (Florice and Miller, 2001). The Complexity is the cutting edge, engineering, lack of corporation between stakeholders with conflict of interest, and change in the laws and regulations (Capka, 2004). It also implies the risk in terms of funding and construction (Frick, 2008).

So megaprojects are complex, yet the definitions does not consider all possible layer, it is just concern with social complexity. We are focusing on the social complexity in order that it's pertinent of trust. Trust is a social context among the internal team members, project manager and sponsor and external stakeholders. Therefore, Social complexity is related to numbers and diversity actors to communicating and working together. social environmental impact assessment will also plugged by strongly misleading (GIGO) (Flybjerg, 2009). Megaproject involve to social and environmental impact and extreme complexity (Capka, 2004). Indeed, Social complexity defines in the Interaction among the people involved (Baccarini, 1996; Bruijn and Leijten, 2008; Cleland and King, 1983). Displacement is as a social-natural process as megaprojects are introduced and associated with colonialism, capitalist, state socialist, recently globalization. The megaprojects failure have impact on devastating consequences such as the bankruptcy of companies/government upheaval (Flybjerg, 2003). However, all things show the complexity is the part of megaprojects. Megaprojects creates potential and actual conflict because of their increase scale, duration, complexity and wide range of external stakeholders (Flybjerg, 2014).

TRUST AND PROJECT

Trust is as a social factors which tradeoffs between organizational goals with those its stakeholders and leads to reduce conflict among stakeholders. One of justification of trust embeded in the project governance. There are several project governance theory which are translating in all organizational level (Enterprise Environment, Portfolio level, Project level). From Agency theory that is Principals delegate decision-making authority to agents. This theory emphasizes on trust between two important internal stakeholders (owner, manager) and it is based on delegation principals in the project level (Berle, 1932; Pratt and Zeckhauser 1985), Steward Theory which provides one framework for charac-

terizing the motivations of managerial behavior in various types of organizations and it has wide range. This theory tries the relationship between two internal stakeholders emphasize (managers and sponsor) on the organizations long term performance and creates the trust building and mutual value creation (Donaldson and Davis, 1991 and 1993). The Resource theory explains the trust in portfolio level for resources prioritization works as a tool to control over resources is a basis of power (Pfeffer and Salancik, 1970). Institutional theory which reveals the social rules and norms for individuals and organizations, therefor, society as a whole, about what people should do in organization and they elaborate the structural theory by focusing that a project is coherent with symbols, belief, norm and practice (Scott, W. Richard 2004). Even though the institutional-based trust fostering security in trust by guarantees, safety nets, or other impersonal structures and situational normality built into the relationship (Encyclopedia of E-Commerce Development, 2016). Therefore, Trust is required in a turbulent environment with high performance risk (Zwikael, Smyrk, 2014). Like middle east.

Stakeholder Theory is individual or organization which could affect / may be affected (positive / negative) on the project outcome (PMBOK, 2017) and applicable only at the project level. Trust and stakeholder management closely manage. Establishing relationships of trust, communication, leadership and interpersonal relationships are facilitated, influencing the increase stakeholder resilience (Gilberto, 2018). Trust has significant role acting as a lubricant in stakeholder relation and project management (Aaltonen, 2011, Aladpoosh et al, 2012). Trust involves to engagement and commitment. Engagement necessitates to involve the employee towards attainment of organizational goals and Commitment is the inner obligation to employee's satisfaction as well as identification with the organization. Every relationship have two part which one of that gives trust and another one receives trust (Gilberto, 2018).

One of key result of trust is that it could impact on the project success. There is the crucial issues about what is the major factors in the project success. Success is one of the most researched topics in project management (Turner and Zolin, 2012). Business Success is meeting the customer goals and business objectives and project management success is fulfilled triple contains (Shenhar and Dvir, 2007). Based on standards, the project success are includ-

ed project objectives such as Scope, Time, Cost management (PMBOK, 2017) or Business objectives such as Financial, Customer objectives (BSC, 1987). It is pertinent to the project outcomes, stakeholder satisfaction, trust building, knowledge creating, gaining organization legitimacy (Pemsel and Muler, 2012).

There are three types of trust: 1) Integrity refers to the authenticity of relations between two parties. Besides, The Integrity is united of heart, brain and tongue. Trust, the confidence in another's will or faith in a partner's moral integrity (Zwikael, Smyrk, 2014). 2) Intuitive relates to the perception left by the other party, and 3) the competence trust has its core legitimacy stemming from the knowledge and skills of the actors involved (Hartman, 2003), and third the Competence is located in the last part. If there are no consistent deliveries to the contractor, none of the types of trust will be retained (Pinto al et, 2009).

All three types contribute to improve trust relationships. Intuitive is the empathy and sympathy which is primarily emotional origin and its more related to socialization. Existing Unaware and resistance stakeholders due to lack of institutive trust. The Intuitive one is preponderant at the beginning of the project, and started after the activities of the stakeholder's management. Certainly, it is seen as key factor in building trust based relationship. Integrity is unification, consolidation and interrelationships among stakeholders to achieve common goals (PMBOK, 2017). Integrity is the main role of project manager / leader as the orchestra leader (PRINCE2, 2017). As case in point, the leadership style can show the integrity trust such as punitive leadership style shows lack of trust (Strahorn et al., 2015), lower cost of litigation management is positive integrity (Hartmann and Hietbrink, 2013). The Integrity is linked to authenticity, transparency, and quality of communication throughout the project and results in relationships of trust (Aubert and Kelsey, 2000). The last but not least, the Competence trust infers in the quality of communication between actors. The precondition of all the types of trust is consistency of deliveries.

Almost, all of them address social aspect and can be associated with mutual understanding, unrestricted learning and inter-organizational knowledge sharing. Moreover, control and commitment are also crucial element of trust. Extensive

control can cause distrust and increase the phenomena of self-serving behavior an underlying disorder.

TRUST AND COMPLEXITY

Trust is a central aspect in many economic transactions (Fukuyama, 1995; Mayer, Davis, and Schoorman, 1995). Indeed, it is built through social interactions with other people and the surrounding environment. Thus, social context should be an important and implied characteristics of trust in prior literature. Source of complexity can help to recognize trust dimensions. Complexity involves in the employed resource, environment, level of scientific and technological knowledge required, number of different parts (large number of required), turbulent environment working on the edge of technology, innumerable possible interaction are certainly identifiable for complex project. Trust is the multifaceted construct (Gefen, Karahanna, and Straub, 2003). It has been conceptualized in a variety of ways (McKnight, Choudhury and Kacmar, 2002). Some of the conceptual confusion on trust is removed by separating beliefs from intended behavior based on the theory of reasoned action (Fishbein and Ajzen, 1975). Trust helps to reduce the social complexity and vulnerability. For example, trust can help to enhance their risk perceptions, thereby encouraging them to engage in the "trust-related behaviors" s (McKnight et al, 2002). Since human interaction is viewed as a precondition of trust (Blau, 1964). The interactions contribute to the trust building and more transparent environment the untrustworthy behaviors will be inhibited. On the other hand, the complexity increases to elimination social cues (e.g., body language), impose additional unique risks (Lee, 1998). Increase customer participation and allow them to collect socially rich information, resulted in a more trustworthy information. Increasing complexity or making results suffer from high multicollinearity because of high correlations among the trust dimensions. When knowledge is missing, decisions and judgments are guided by social trust. Therefore, Trust may be viewed as a mechanism to reduce the complexity faced by people (Earle and Cvetkovich, 1995; Luhmann, 1989). Trust measurement is much difficult and strongly depends on complexity like confidence of information flows determines how the interactions occur in the project, and may even grow in complexity with the increase of these exchanges (Karlsen et al., 2008; Rolstadås and Schiefloe, 2017).

RESULTS

Lack of infrastructure, overflow natural resources, high ranked in oil and gas sources and existing talented resources could be cause for particular position of Iran. Honestly, Iran is impacted by lot of sanctions which they leads to economical huge effects. Iran inflation rate dramatically changes during years ago from around 37% to 52% (workbank.org). However, the political and environmental conditions could impact on Iran economy. Meanwhile, we are selecting the two megaprojects in the infrastructural field. Both of them were megaprojects and come from the mineral industries. The one project is related to magnesium steel which has budget around 1 billion euros, duration is around 6 years and belongs to Khuzestan Steel Company (KSC) which is called "ZamZam". The Second one is "Torbat" which is the governmental project and the project strategic is creating over 3 million job position as well as its over 1 billion euros.

After review pertinent research articles, we examine the atmosphere of high inflation countries with concentrate on Iran. We must select key stakeholders from both megaprojects because the trust is serious depending on them like sponsors, prime contractors, clients, customers, governmental entities (Government is a one of important external stakeholders). One of challenge is the stakeholder classification that carry outs based on power / interest in the stakeholder and every stakeholder which has highest power

and interest to project outcomes (PMBOK, 2017). The last researches had been paid attention to internal stakeholders, but this approach creates potential conflict, because of megaprojects involve to scale, duration, complexity and wide range of external stakeholders (Flyvbjerg, 2014). The stakeholder engagement management is included to analyze their interest, interdependencies, needs and expectations (PRINCE2, 2017). Therefore, the stakeholder management can help to establish the trust factors. Our method were the exploration method and we are carrying out the semi-structured interview with focusing on key stakeholder from all parties (internal / external). As a following table, we point out the megaproject characteristics and the trust factors based on academic researchers and anecdotal evidence in our case studies. We focus on case studies and interview with key stakeholders and even though non-stakeholders.

There are considering the three trust type: 1) intuitive 2) integrity and 3) competency. It consolidates with megaprojects characteristics like Hass, 2009 and take into account the stakeholder exploration analysis. Consequently, the key trust factors are identified and categorized. All propose trust factors were based above three categories and is linked to megaproject characteristics. We must take in account all key stakeholder reservations during semi-structured interview which is illustrated as following:

Table 1. (Key Trust Factors)

MEGAPROJECT CHARACTERISTICS	TRUST FACTORS	TRUST TYPE
Size: Multiple diverse teams	Stakeholder management engagement	Intuitive
	Improve communication skills	Competence
	Leadership style	Integrity
Time:Over 12 month	Transparency	Integrity
	stakeholder satisfaction- preparing plans	Competence
Cost: equal / over 1 billion US dollar	Transparency	Integrity
	stakeholder satisfaction- preparing plans	Competence

	Project decision methods	Competence
Schedule/ Budget: Aggressive	Risk management	Competence
	effective collaboration	Integrity
	Improve communication skills	Competence
	Leadership style	Integrity
	Defining roles and responsibilities	Competence
Team Composition: Matrix Based	Conflict management	Integrity
	Delegation	Integrity
	Existing the project organizational chart	Competence
	Code of ethic	Integrity
	Transparency	Integrity
Contract: Highly Complex	Risk management	Competence
	Mutual understanding	Intuitive
	Transparency	Integrity
	Mutual understanding	Intuitive
Customer Support: Inadequate	Emotional intelligent	Intuitive
	Stakeholder satisfaction	Competence
Requirement: Uncertain / evolving	Risk management	Competence
	Respect	Integrity
Political Implications: Impact on Organizations, states and countries	Improve communication skills	Competence
	Emotional Intelligent	Intuitive
	Improve communication skills	Competence
Communication: complex	Stakeholder management engagement	Intuitive
	existing the project organizational chart	Competence
	Stakeholder management engagement	Intuitive
Stakeholder Management: Multiple organizations, states, countries, regulatory groups	Improve communication skills	Competence
	Emotional intelligent	Intuitive

	social capital	Integrity
Stakeholder Management: Multiple organizations, states, countries, regulatory groups	Benevolence and credibility	Integrity
	Effective collaboration	Integrity
Organizational Change Impact on: Multiple organizations, states, countries; transformative, new venture	Organizational learning	Integrity
Commercial Change: Ground-breaking commercial and cultural practices	Preparing plans	Competence
Risk Level: Very high	Risk management	Competence
	Transparency	Integrity
External Constraints: Project success	Stakeholder	Intuitive
Depends largely on External organizations, states, countries, regulators	Management engagement	
	Respect	Integrity
	Organizational learning	Integrity
	Transparency	Integrity
Integration: Unprecedented integration effort	effective collaboration	Integrity
	Benevolence and credibility	Integrity
	social capital	Integrity
	Leadership style	
Technology: Groundbreaking Innovation and unprecedented engineering	effective collaboration	Integrity
	Improve communication skills	Competence
IT complexity: Multiple “systems of systems” to be developed and integrated	stakeholder management engagement	Intuitive
	existing the project organizational chart	Competence
	Preparing plans	Competence
Suck cost: incurred cost	Project decision methods	Competence
	Stakeholder management engagement	Intuitive

	Preparing plans	Competence
Illusion of Control: high degree of uncertainty	Risk management	Competence
	Improve communication skills	Competence
	Organizational learning	Integrity
Commitment: obligation / legal requirement	effective collaboration	Integrity
	social capital	Integrity
	Benevolence and credibility	Integrity

ANALYSIS

We use the Nominal Group Technique and Delphi Method for analyzing and creating prioritized list. The Key Factors prioritized list is established based stakeholders preferences, regardless as internal and external stakeholders in our segmentation. We want to foster the convergence among stakeholders. Therefore, we could generate the list as following factors respectively:

- **Risk management:** the risk management is preventive action before the risk is about to occurrence. The loss of trust among stakeholders is the controversial risk. Trust plays the substantial role in the stakeholder relationships and risk can occur inside and outside of organizations. Thus, the risk and trust intersects with each other. Trust is an extremely valuable when internal / external changing is dramatically. Risk management can forecast and response to changes and help to sustaining consumer loyalty.
- **Effective collaboration:** It is resulted by interdependencies, empathy and trust. To building trust, the team collaborates together and facilitates the collaborative sprite of what we work better with people we like and we trust.
- **Preparing plans:** Trust is a central element of planning (Lucie Laurian, 2009). Planning has the various aspect such as project management knowledge areas like time, cost, scope, quality or strategic planning such as strategic map or the variety levels like project, stage, delivery level (PRINCE2, 2017).
- **Benevolence and credibility:** the dimensions of inter-firm trust are benevolence and credibility as the key factors (Aurifeille and Medlin, 2009). The credibility includes the combination of honesty, reliability and expectancy; whereas benevolence has rarely been examined as a unique dimension. Indeed, both of them are pertinent of business relationship performance.
- **Social capital:** the Francis Fukuyama said: "social capital is a capability that arises from the prevalence of trust in a society or in certain parts of it". Social capital can impact on the level of trustworthiness. Consequently, the social capital and trust are fostering the project management success. Overarching view, the social capital depends on religion, norm, value, attitude tradition as well as it's embedded as a trust factor.
- **Improve communication skills:** the effective communication between sender and receiver and especially the effective listener as an interpersonal skill which can be establish trust among all stakeholders. Getting feedbacks help to mutual understanding of message (PM-BOK, 2017). The effective communications is directing to building trust through communication skills and even though the nonverbal communications.
- **Stakeholder satisfaction:** It is perception of quality of relationship within needs / desirable level (Kostas N. Dervitsiotis, 2010). It fosters the sustainable stakeholder trust as a crucial role in the trust building.
- **Project Decision methods:** In megaproject the decision maker might come from outside of the organization

and belong to society (Hueskes et al, 2017, shiferaw et al, 2012). There are several methods like Quality Function Deployment (Akao 1990), Analytic, Hierarchy Process (Vaidya and Kumar 2006), Choosing by Advantages (CBA) – CBA is based on the fundamental rule that decisions must be based on the importance of advantages (Suhr 1999), Design Scenarios (Gane and Haymaker, 2012), Weight, Rate, and Calculate (WRC) methods, have users weigh the importance of objectives, rate the performance of alternatives, and calculate the value of each alternative through a value function combining weights and ratings (Tague, 2004).

- **Stakeholder engagement management:** Stakeholder engagement management, improving democracy for selection of more suitable governance mechanism (Xie et al., 2017). It differs from Stakeholder Management because its focus on the relationships and influence of stakeholders and it has principals such as communicate, consult, humans only, compromise, plan it, understand what is success, managing risk and is closely related to trust (APM, 2017).
- **Emotional intelligence (EI):** It is equal to empathy and the capability of individuals to recognize their own emotions and those of others, distinguish between different feelings and/or adjust emotions to adapt to environments or achieve one's goal(Emotional Intelligence: overview, 2019). Empathy is lead to establish trust between stakeholders (external and Internal).
- **Organizational learning:** It is the process of creating, retaining, and transferring knowledge within an organization. Some researchers assess knowledge as changes in an organization's practices or routines that increase efficiency (Gherardi, Silvia, 2005). Knowledge management is the process of collecting, developing, and spreading knowledge assets to enable organizational learning (Icacer, Juan; Gittelman, Michelle; Sampat, Bhaven, 2009). It intertwines with trust factor.
- **Transparency and ethics:** the first influence of trust and ethic over government is the enhancement of making decision for organizational participant who are facing different dilemmas (Muller et al, 2013, Walker and Lloyd Walker, 2014). Visibility refers to partner's transparency

to proactive reveal and show the strategically relevant intent and alignment refers to for among partners so that benefit are assured without clashes (Nguyen, 2011).

- **Respect:** it is so difficult to separate trust and respect. Respect is soliciting, but trust is acquiring. Indeed, trust establishes credibility, loyalty and mutual respect as well as the respect maintains trust and improve work environment and prevent negative consequences to achieve trust.
- **Leadership styles:** The leadership style like transformational, transactional, and laissez-faire and employees' trust move toward organizational change capacity (OCC) (Yasir, Imran, 2016). Building trust is akin to allowing the team to make their own decisions(Laissez-faire), demonstrates commitment to serve and put other people first(Servant leader), accomplishment to determine rewards(Transaction), inspirational motivation(Transformational), self-confident(Charismatic) or combination of transactional, transformational, and charismatic(Interactional) (PMBOK, 2017).
- **Other factors** like legitimacy, resource prioritization methods, conflict management, existing portfolio management, skilled team members, accountability, loyalty, Information Management and political and cultural awareness were other factors which are implication during our interviews.

The gathered data from interviews with key stakeholders include client, prime contractor, customer, governmental agencies, team members, Managing Contractor (MC), General Contractor (GC), Sponsor presents Key Trust Factors (KTF) which were screened above mentioned. Overall, the social complexity were dominated by KTF during the interview meeting, rather than other complexity like task and cultural complexity.

As the results, more than 75% applicants has selected the risk management, Effective Collaboration, planning and transparency as a high priority trust factors, while 25% offered other factors..

Obviously, the megaprojects have various problems with high economical fluctuations in Iran now. The underlying reasons are instability in the economic conditions, high in-

flation rate and tough sanction. On the contrary, the megaprojects initiation dramatically increase during ten years ago, due to the financial resources are no longer available, usually the megaprojects went to defer. The trust factor list sketches based on high inflation countries but it is evolved by other megaprojects from various countries.

DISCUSSION

This paper is examined with the aim of scrutinizing trust factor in the high inflations countries which was focused on Iran. Nowadays, the Middle East is origin of the various crisis in the world. However, Iran was the central attentions of our research among Middle East countries. Because of the fact that Iran is under tough sanctions that it has more inflation rate than other countries like Iraq, Afghanistan or even though Syria. We were clearing the megaproject definitions and their characteristics. Megaprojects (which are generally defined as those costing more than 1 billion USD) tend to have large numbers of project participants arranged within a governance structure (Gil, 2015). the Megaproject has different stakeholders with different cultures and sometimes contradicting demands and high levels of risk, especially in the project selection and decision-making phase, were found to be the most studied topics in this field (Guo et al., 2014; Van Fenema et al., 2016; Kivilä et al., 2017; Ma et al., 2017; Xie et al., 2017). Researching megaprojects has recently become a topic of interest (Flyvbjerg and Turner, 2017). With so many resources invested in megaprojects, never has the management of such projects been more important (Flyvbjerg, 2014). Undoubtedly, the complexity is closed relationships with megaproject which is obvious aspect of megaprojects. The research shows the megaproject aspects and all theories which are related to this context. Complexity is an inherent and indispensable part of megaprojects. Megaprojects are often international scope as they involve the participation of sponsor, funding agencies and contractors from multiple countries. Key features of global megaprojects: large scale, major infrastructure projects usually commissioned by government and delivered by private contractors. The trust, complexity and megaprojects are our subject and compiling trust factors based on review all gathered data form two Iranian megaprojects through interviews with stakeholders (internal / external). In addition, the checklist was established to considering all the key trust

factors. This paper has a number of limitations. First, I have samples from two megaprojects in Iran which was used in this study. Although, both of them have to gather data via face to face meeting and based on semi structure interview, but we can't carry out based on online devices from wide range of respondents. Second, a single countries data was used for this study. In spite of that other high inflation countries were in the Middle East zone like Afghanistan, Iraq, and Syria and even though the other Middle East countries like Oman. The whole data could create the holistic overview in our research. Third, the checklist was tested only with the data collected from Iranian culture and in the Mining industries. The results might be tailored to other cultural context. Future study is also needed for testing the model in the different cultures. Fourth, we use only the Nominal Group Technique, but we can use the other quantitative statistical analysis which verifies the Key Trust Factor list. Finally, we have checked the effects of some key factors on trust; however, this paper cannot address all these possible trust factor, such as, code of ethic, legitimacy, resource prioritization methods, conflict management, existing portfolio management, skilled team members, accountability, loyalty, Information Management and political and cultural awareness. Additional research is also needed to determine the effects of these factors.

On the other hand, according to above mentioned, this paper could be more important to researches because: First, we examined and tested multicultural megaprojects which are concentrate on Middle East zone. Future research can examine to high dispersion projects across high inflation countries. Second, there is the vacuum place to define the trust index and measure based on quantitative approach. . Third, social context can impact on trust factors perception, however, we are ready to research to various society, not just Middle East zone. Fourth, we can change the research method to survey method from wide range of respondents for megaprojects practitioners. Besides, we can use online devices to enhance the accurate results. Thus, future research can explore the trust factors especially for external stakeholders, because the previous researches had emphasized to internal stakeholders.

Finally, we can show a more complete model that includes both internal and external stakeholder from walk of life and from multicultural and various countries.

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Enhancing Stakeholders' Trust in Megaproject Supply Chain through Blockchain: An Exploratory Study

ABSTRACT

Mega projects have brought numerous benefits to the society. There are an increasing number of mega projects over the past decade and it is predicted that the magnitude and frequency of mega projects will continue to increase in the coming years. Due to the complexity and large scale of mega projects, there is a lack of trust in the supply chain of mega projects, especially for which involve global sources and suppliers. Thus, this study aims to explore the potential of applying blockchain technology in the supply chain of mega projects. One chemical mega project was selected as case study. Through the case study and viewpoints of participants, the barriers to applying blockchain technology in the supply chain of mega projects were summarized. The future study will be conducted to propose and evaluate a blockchain-based supply chain framework for mega projects.

Keywords: Trust; Mega-project; Blockchain; Stakeholder; Supply Chain

1. INTRODUCTION

Although major or mega project are costly, they have brought numerous benefits, such as technological inspiration, providing a large number of jobs, political accomplishment, economic benefits, and aesthetic beauty (Flyvbjerg, 2014; Frey, 2017). Over the past decade, mega projects have experienced a significant growth and it is expected that the investment in mega projects will continue to increase in the coming decade (Flyvbjerg et al., 2003; Woetzel et al., 2017). The complexity and large scale of mega project pose a great challenge in building and maintaining trust

among stakeholders, especially for globalised supply chain. Inefficient transactions, fraud, and poorly performing supply chains result in a lack of trust, and thus there is a need of an effective information sharing technique for improving the trust in supply chain of mega projects (Saberi et al., 2019). Trust represents one of the promises of the blockchain (Hawlitschek et al., 2018). The study aims to explore the possibility and difficulties of applying blockchain technology in the supply chain of mega projects to improve the trust within all stakeholders. The transparency and traceability of material and equipment in supply chain supported by blockchain were examined through case study. A mega project case in China was selected and analysed to test how the blockchain technology can be used in supply chain. The blockchain technology was applied on the supply chain for an important equipment of the selected mega project.

2. LITERATURE REVIEW

2.1. Mega projects and trust

Mega project is defined as a complex and large-scale project with a substantial capital of more than one billion dollar, requiring efforts from many participants in terms of resources, skills, and expertise (Flyvbjerg, 2014). Mega projects can be categorized into transport infrastructures (e.g., high-speed or light rail projects, bridges, and tunnels), oil and gas extraction, defense and aerospace, water and dams, power supply, and urban development (Flyvbjerg, 2007; Gellert and Lynch, 2003). Although mega project are costly, they have brought numerous benefits, such as technological inspiration, providing a large number of jobs, political accomplishment, economic benefits, and aesthetic beauty, which

drive the development of mega projects (Flyvbjerg, 2014; Frey, 2017). Over the past decade, the global mega projects have experienced a sharp increase in the magnitude and frequency of mega projects (Flyvbjerg et al., 2003). In addition, it is expected that an average of \$ 3.7 trillion per year of global spending on infrastructure projects to 2035 is required for keeping pace with GDP growth (Woetzel et al., 2017). Asia has taken in the lead in building mega infrastructure. Around 54 percent of global spending need will concentrate on Asian countries, especially for two most fast-growing and most populous countries: China (34 percent) and India (8 percent) (Woetzel et al., 2017). Approximately 20 percent and ten percent of the global need will be in United States and Western European countries, respectively. Frey (2017) predicted that mega projects will increase from around eight percent of global GDP to approximately 24 percent within a decade.

However, there is a paradox, as revealed by Flyvbjerg et al. (2003). One the one hand, there are increasing mega projects that are being proposed and built globally. On the other hand, many mega projects have performed poorly and are inefficient in terms of time, cost, quality, environment, and public support (Flyvbjerg et al., 2003). For instance, Flyvbjerg (2014) found that 90 percent of mega projects worldwide have cost overruns which are common in both private and public sector projects. A comprehensive survey of Australian mega projects revealed that 21 out of 44 mega projects failed to achieve satisfactory time and cost (Australian Constructors Association, 2015). The complexity and scale of these mega projects make them difficult to manage. Anderson Jr and Polkinghorn (2008) revealed that major projects are a notorious cauldron for conflicts among owners, contractors, designers, and the public. Mok et al., 2015 stated that the large scale and complexity of mega projects increase the difficulties of their project management in three aspects: (1) the growing capacity and dynamics causing a high project uncertainty (Yeo, 1995); (2) the participation of many stakeholders causing complicated interrelationships and conflicting interests among stakeholders; and (3) the governance by a stringent multi-role administrative structure causing more public attention and controversies (Yeo, 1995). It is of great importance to deliver these projects effectively and efficiently, which will lead to saving huge amounts of capital and benefits to the economy.

According to the survey of Armstrong (2015), merely 33 percent of owners regarded the level of trust in contractors as high, while around 60 percent expressed they have a moderate level of trust in contractors. Khalfan et al. (2007) found that the scope, size, and complexity of projects have an impact on the level of trust that can be maintained in the project. Smaller projects involving less participants and limited number of relationships make them easier to build and maintain trust. Larger projects with more people may limit opportunities for working with some partners. Furthermore, in larger projects, the cost of decisions to trust is higher due to a higher value, which may affect the decision of trust, while in smaller projects, there is a higher level of trust due to the lower value and risk of decision to trust. Thus, it is difficult to build and maintain trust in the complex and large-scale mega projects.

2.2. Blockchain technology

Blockchain is a digitized decentralized database shared among its users to record all peer-to-peer transactions without the third party customarily trusted to authorize (Hawlitschek et al., 2018). The database can store a ledger of extensive range transactions information includes currency, property, titles, and history of ownership (Hansen and Kokal, 2018). Traditional transaction relies on the authentication of high credit units such as banks and government. Nevertheless, blockchain is maintained by consensus protocol which means transactions are shared and supervised amongst all participated nodes (computers) of the network (Koulouri-Fyrigou, 2018). The first block is called genesis block, which was created on January 3, 2009, by Satoshi Nakamoto. It contains the headline of 'The Times' newspaper on that day: "The Times 03/Jan/2009 Chancellor on brink of second bailout for banks" (Cocco and Marchesi, 2016). The process of how blocks form a blockchain is presented in Figure 1. To add new blocks, terms and conditions of new transactions will be broadcasted to the entire network and waiting to be verified by other nodes. The participate nodes are also known as miners, who are creating new blocks on the blockchain through a procedure called 'proof-of-work' (Koulouri-Fyrigou, 2018). This procedure is based on Hash function, encoding of data into a small and fixed size and used in cryptography. It requires miners to find a number called nonce, and the proof is easy to be com-

pleted for computers but costs time (Cocco and Marchesi, 2016). Then the competition among miner starts, each of miner records the new transactions into their new block and tries to solve the task as fast as possible. The first miner finished the job and connected the new block on blockchain is rewarded by cryptocurrency, which is also the incentive of nodes to maintain the operation of blockchain (Sillaber and Waltl, 2017). As a result, each block will be recorded with the time step and a cryptographic hash of the previous block. Blocks are added in chronological order and cryptographically linked, which makes the irreversible chain monitored and enforced without a third party (Bridgers, 2017).

everyone's ledger and each user will verify the data. After this procedure, this new block will be added to every user's ledgers and every copy of blockchain in each node will be a consensus. If one block has tampered at one node, other nodes will reject, and this rejected node will be invalid (Ryan and Donohue, 2017).

Compared with the centralized operation system, the decentralized operation system has a complete management system at the start of the work, such as banks. They can deal with the problems by some methods already presented, whereas the centralized system has a low improve-

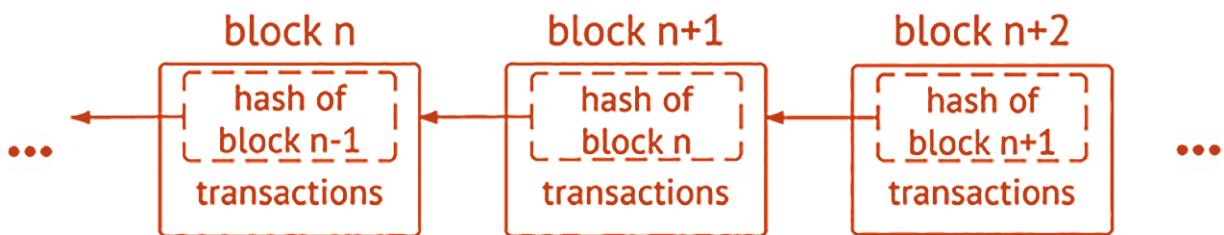


Figure 1. How do blocks form a blockchain (source: Christidis and Devetsikiotis (2016))

As mentioned above, the blockchain is a database, which is stored on the Internet and allows the financial trading and data recording. The blockchain system is decentralised, not like the traditional databases that are centralised like banks and governments. Blockchain is a digital ledger for the financial transactions, which can store information permanently across a network of each user in the blockchain. In the blockchain database, each block can hold numerous transactions and blocks are timestamped. For instance, a single block can store more than 500 transactions (Di Pierro, 2017). Once the data are stored in a block, it is impossible to be changed or hacked. There are two critical elements in blockchain, one is a distributed ledger and another one is cryptography (Di Pierro, 2017).

Nowadays, the most commonly used financial system is a centralized ledger through the network. Banks get paid for verifying the transactions and make a record to the central ledger. The blockchain uses a peer to peer network which is a decentralised network, and anyone can join it. Everyone enters the blockchain network will get a copy of the whole blockchain which means everyone can verify the transactions. When there is a new block formed, it will show on

ment speed in the future and the improvement speed only depends on their own employees' work. On the other hand, the decentralised system did not perform as good as the centralized system as the start, but it will be optimised faster than centralized system because of a large number of online contributors.

A blockchain is a distributed ledger which consists of a series of blocks added in chronological orders. The operation of blockchain needs the nodes in the whole network and has three significant characteristics: decentralization, transparency, and security.

- DECENTRALIZATION

Different with traditional transaction method, there is no central organization or server as transactions in every node in the network (Hansen and Kokal, 2018). Compared to the traditional transaction system, blockchain is much cheaper to maintain and costs less time. The benefits of decentralization are short duration and low cost. For instance, the Ripple can complete the transaction in five seconds, where the traditional banking process may need days. It can reduce the bank cost by 33 percent (Neyer and Geva, 2017).

- TRANSPARENCY

As a distributed ledger technology, all transactions are accessible through nodes and data are sharing. Any-one could check the data and track the history through a computer of the network to make sure the reliability of information. For example, a unique blockchain ownership certificate of land title can be created. The buyer could access the information of the property through blockchain and check the trading record without any worry of the forgery (Hansen and Kokal, 2018).

- SECURITY

As the blocks are added in chronological orders and contain a cryptographic hash of the previous block, the recorded data on blockchain cannot be tampered, altered, concealed or falsified. As the transaction is transparent to every node on the network, hacking is theoretically impossible unless someone invades every single computer (Bridgers, 2017).

2.3. Smart contract definition and procedure

One of the most significant applications of blockchain is smart contract. The concept of smart contract was first introduced by Nick Szabo in 1994, who explained how the codification contract can be executed on the computer network without the intermediaries between participate parties (Christidis and Devetsikiotis, 2016). Blockchain technology can be used to improve the smart contract by operating it on blockchain and enforcing the obligation by consensus protocol. Once the preconditions of participated parties are met, the smart contract stored on blockchain can execute automatically on all nodes of networks (Ølnes et al., 2017). The transparency of blockchain is also applied in the use of smart contract, so it is impossible to interrupt or interfere by any party alone. As the implementation of the smart contract is executed by all nodes on the network, participants can trust each other without the third party (Sillaber and Waltl, 2017).

The procedure of using smart contract is divided into four steps: creation, freezing, execution, and finalization, as shown in Figure 2.

- CREATION

Similar to the traditional contract, the first step of a smart contract is to determine the agreement on the

content, clauses, and intentions of the contract between participate parties. To identify all parties and ensure the feasibility of transaction, blockchain accounts must be provided (Sillaber and Waltl, 2017). The following step is programming the content of contract into specific smart contract coding language. To express the requirements of the clause accurately, programmers need to repeatedly test the code until it is impeccable. After the codified contract approved by parties, it will be uploaded to the distributed ledger and confirmed by participated nodes as a transaction block (Ølnes et al., 2017). The smart contract is impossible to be modified anymore from this point.

- FREEZING

After the smart contract is uploaded to the blockchain, the smart contract and participated parties are open and transparent to the public ledger. Participated nodes fulfil the obligation of supervision. All blockchain accounts involved in the smart contract are frozen until the preconditions are met (Sillaber and Waltl, 2017).

- EXECUTION

The execution of the smart contracts requires the input to be active. Smart oracles are the agents who connected the smart contracts with the real world. As a part of a smart contract, oracles verify the real-world events and upload authentic information to the smart contract for further judgment. Once the execution is implemented, transactions and updated state of smart contract will be submitted to the blockchain (Ølnes et al., 2017).

- FINALIZATION

After the execution of the smart contract, transactions and updated state of smart contract in the distributed ledger is verified by participated nodes. All blockchain accounts involved are unfreezing and the smart contract is fulfilled (Sillaber and Waltl, 2017).

2.4. The Application of blockchain technology in supply chain

Blockchain technology has been applied in the supply chain in various sectors, such as food and beverage industry and textile industry. For instance, Yanovich et al. (2018) analysed blockchain-based supply chain for postage stamps and re-

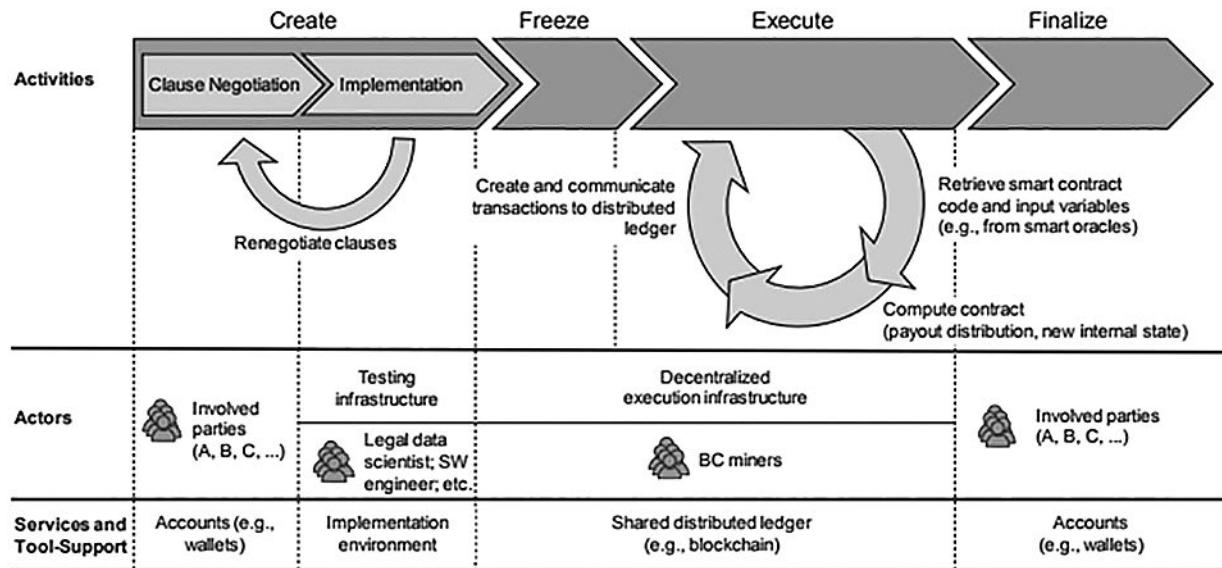


Figure 2. The life-circle of smart contract (source: Sillaber and Waltl (2017))

garded it as an effective solution for ensuring transparency of postage stamp market and guaranteeing the invariability of stamps volume. ElMessiry and ElMessiry (2018) proposed a complete blockchain-based framework to improve textile quality considering that textile supply chain is large and complex and involves global resources and suppliers. Casado-Vara et al. (2018) presented a blockchain method in which all transaction information in supply chain was stored and suggested that multi-agent system using smart contracts is more efficient for managing the whole supply chain. They also regarded that their proposed model can be improved with the help of a case-based reasoning system. Bettín-Díaz et al. (2018) proposed a methodology integrating blockchain technology in the supply chain of food industry for improving traceability and providing the customers with information regarding the origin of products. Saberi et al. (2019) explored the application of blockchain in sustainable supply chain management and identified four categories of barriers to the adoption of blockchain, including intra-organizational barriers, inter-organizational barriers, system-related barriers, and external barriers. In order to better applying blockchain in supply chain management, Treiblmaier (2018) built a framework based on principal agent theory, transaction cost analysis, resource-based view and network theory and they regarded that the block-

chain technology can significantly improve the supply chain management.

2.5. Limitation of blockchain

Although the blockchain technology has gained wide acknowledgement from both academic and business industry, there are still many limitations. Firstly, the blockchain technology is not mature on the business level yet. There are few applications being implicated in real life from blockchain technology, and most of the blockchain projects still stay in theoretical and ICO (Initial Coin Offering) period. Wasted resources problem, usability problem, and data malleability problem are still needed to be fixed (Yli-Huumo et al., 2016). Furthermore, Mik (2017) also pointed that current level blockchain and smart contract can only handle with the simple online transaction. The data source that provided for the smart contract from off-chain events can be complicated to identify, which indicates that the application for smart contract is limited to solve on-chain transaction problem. Moreover, Mik (2017) also indicated that real-life scenario can be far more complicated than the contract itself, and it is very challenging to use smart contract to deal with real-life scenarios. Therefore, in this study, we use a real megaproject procurement case to explore the possibilities of applying blockchain.

3. CASE STUDY

3.1. Overview of the selected mega project case

In this study, the feasibility of applying blockchain in the supply chain of mega projects is explored through case study. A large scale and complex chemical project in China with an investment totalling over \$1.2 billion was selected for case study. The contract of this project is Engineering, Procurement, and Construction Management (EPCM). The Contractors need to provide engineering, procurement, construction management, and project coordination services under the Contract Condition of EPCM. The EPCM Contract is a fixed price contract, which referred to the FID-

IC Turnkey Contract Condition, such as the responsibilities and obligation of Engineering and Procurement. Apart from these responsibilities, the EPCM Contract should execute the right of construction management as an Owner's Representative under the Contract Condition of Construction. Moreover, one construction company was appointed by the Owner as a Nominated Subcontractor, which is responsible for completing project's construction. The construction phase started in 2012 and completed in the end of 2014. The key participants and their scope of work are shown in Table 1. In this mega projects, many materials and equipment were manufactured globally, such as China, German, and the United States.

Table 1. Key Participants involved in the selected case

KEY PARTICIPANTS		SCOPE OF WORK
1	Owner	Review and approve
2	EPCM Contractor (Owner's Representative)	Engineering, procurement, and construction Management
3	Nominated Subcontractor	Construction
4	Vendors	Material and equipment supply

In the process of project execution, key personnel of parties played a crucial role in the approval process of the Interim Payment. Some key personnel of owner include discipline manager, control manager, and contract manager and the key personnel of EPCM contractor include document control team, procurement team, discipline engineer and site manager, estimator and project control manager, contract administrator and contract manager, and project manager. The supply chain of materials and equipment of this mega project is described in the following sections.

(1) The vendor supplies and delivers the material and equipment based on the supply agreement. Typically, for delicate and expensive materials and equipment, the procurement team will arrange an engineer to monitor the process of manufacture to match the requirement of technical specification in the supply agreement.

(2) The material and equipment should be delivered to the nominated warehouse. The procurement engineer of EPCM Contract and the Nominated Subcontractor should check the quantity and visible damage jointly. The parties should sign on the acceptance form, and the responsibility of care and custody will transfer to the Nominated Subcontractor under the Condition of Construction Contract. Otherwise, the procurement team should instruct the vendor to remedy damaged material or equipment. If the offshore procurement, the procurement team tends to choose an onshore supplier from the procurement shortlist to complete the remedy to decrease the cost of transportation and avoid delay. In the second scenario, the procurement team needs back-charge to the original vendor.

(3) The Nominated Subcontractor should pick up material and equipment from the warehouse and perform the work as per the requirement of Bill of Quantity (BOQ). During the

construction, the discipline engineer should monitor the construction process on site. They verified the quantity of completed work and update construction log daily. After completing the material assembly or equipment installation, the Nominated Subcontractor should submit a progress payment for EPCM and Owner's approval. However, sometimes, some material or equipment cannot be assembled or installed successfully according to the indication of shop drawing. Then, the Nominated Subcontractor should write a Require for Information (RFI) to inquire the discipline engineer how to deal with these problems.

3.2. Main procedures of applying blockchain in the procurement phase

This study adopted the procurement of distillation tower to test the feasibility of applying blockchain in the supply chain. The main procedures of applying blockchain technology in the procurement of distillation tower can be divided into the following stages.

(1) Step 1: Contract Creation

The distillation tower as an important equipment in this mega project needs to be purchased overseas and installed as per scope of work of construction contract. The procurement team is responsible for procuring this equipment. The procurement team of EPCM contractor needs to sign a supply agreement with the vendor. The total contract price of distillation tower is AUD 43,000. The procurement team will pay 30% of contract price as deposit to the vendor. The vendor will supply and transport the distillation tower to a nominated warehouse. Once the procurement team receives and inspects the equipment, they will pay the remaining to the vendor.

A testing contract based on above information is presented in Figure 3. The vendor and procurement need to obtain the different address to access and administrate work interface, respectively. The system creates an equipment supply contract after the code can be compiled and run successfully. After contract deployment, the vendor's address, the name

The screenshot shows the Truffle UI interface. On the left, a code editor displays the Solidity smart contract code. The code includes modifiers for vendor and procurement, and functions for initializing the contract and making a purchase. On the right, there is a deployment interface with fields for vendor address, product name, and price, along with a 'Deploy' button and a 'Transactions recorded' section.

```
address payable public vendor; //0x439d61956bC06FAbB4F3d2C3cdA004bdE6b508D2
address payable public procurement; //0x75873e0B8Ab42aA08933BC66B27C7776a1EA7CE3
uint256 internal deposit;
uint256 public remaining;

modifier onlyVendor() {
    require(msg.sender == vendor);
}
modifier onlyProcurement() {
    require(msg.sender == procurement);
}

string public productName;
uint256 public price;
string public status;

// initial the contract
//
// as a founder
// enter vendor address
// enter procurement address
// enter product name
// enter product price
constructor(address payable _vendor, string memory _name, uint256 _price) public {
    //constructor() public {
        procurement = msg.sender;
        vendor = _vendor;
        productName = _name;
        price = _price;
        deposit = price * 3 / 10;
        remaining = price;
        status = "started";
    }
}

// complete whole transaction
// only the procurement can run this function
//
// make the deposit (Product price * 0.3) of the Product
function buy() payable public onlyProcurement{
    require(statusIs("started"));
    require(msg.value >= deposit);

    transferETH(vendor);
    remaining = price - msg.value;

    status = "paid deposit";
}
```

Figure 3. Contract creation

of equipment, and price will be input in the system according to the supply contract (see Figure 3). When the procurement team confirms the contract, they will pay transaction

fee to the Ethereum for creating contract in blockchain and then the corresponding block is created in the blockchain (see Figure 4).

Figure 4. Transaction fee and block created in step 1.

Note: The left part is the screenshot of transaction fee paid by procurement team for creating contract; the right part is the screenshot of the record of contract creation in Ethereum blockchain in step 1.

(2) Step 2: Purchase

When the procurement team performs the purchase action, AUD 12,900 (30% of contract price) will be pre-paid to the vendor as the advance payment of equipment according to the requirement of supply contract. If the advance payment is less or more than AUD 12,900, the system will occur error warning. After the correct ether coin is input by procurement team, the buy action is successful, and the status of deployed contracts is shown in Figure 5. In addition, the procurement team needs pay some transaction fee to Ethereum and the record of buy action will be added in the blockchain (see Figure 6).

Figure 5. The status of deployed contract in step 2

The screenshot shows a blockchain interface with two main sections. On the left, a 'procurement' user interacts with a 'CONTRACT INTERACTION' screen. It displays a balance of 0 Ether, transaction fees, and a total amount. Two buttons at the bottom are 'REJECT' and 'CONFIRM'. On the right, a 'Transactions' tab is selected, showing the 'Latest 2 txns' in a table. The table includes columns for TxHash, Block, Age, From, To, Value, and [TxFee]. The first transaction is from 0x75873edb8a... to 0xaba708b582..., and the second is a 'Contract Creation' transaction.

TxHash	Block	Age	From	To	Value	[TxFee]
0xc4cb20cfbf2...	10724254	1 min ago	0x75873edb8a...	0xaba708b582...	0.00000000000012 Ether	0.000046897
0x5a3191c788e...	10724232	8 mins ago	0x75873edb8a...	IN Contract Creation	0 Ether	0.001153706

Figure 6. Transaction fee and block created in step 2.

Note: The left part is the screenshot of transaction fee paid by procurement team for paying the deposit; the right part is the screenshot of the record of Ethereum blockchain in step 2.

(3)Step 3: Equipment delivery

When the vendor received the advance payment, they will be responsible for transporting the equipment to the nominated place. In the system, the vendor needs to carry out the "send" action, and the status of deployed contract will be updated as shown in Figure 7. The vendor also needs to pay transaction fee to Ethereum in order to add the record to the blockchain (see Figure 8). Thus, the transaction regarding the equipment delivery is added to the latest block of the blockchain in step 3 (see Figure 8).

price	0: uint256: 43000
procurement	0: address: 0x75873eDB8Ab42aA0B933BC86B27C7776a1EA7CE3
productName	0: string: Distillation Tower
remaining	0: uint256: 30100
status	0: string: dispatched
vendor	0: address: 0x439d61956bC06FabB4F3d2C3cdA004bdE6b508D2

Figure 7. The status of deployed contract in step 3

The screenshot shows a blockchain interface with two main sections. On the left, a 'vendor' user interacts with a 'CONTRACT INTERACTION' screen. It displays a balance of 0 Ether, transaction fees, and a total amount. Two buttons at the bottom are 'REJECT' and 'CONFIRM'. On the right, a 'Transactions' tab is selected, showing the 'Latest 3 txns' in a table. The table includes columns for TxHash, Block, Age, From, To, Value, and [TxFee]. The transactions show the vendor sending Ether to the procurement address and creating a new contract.

TxHash	Block	Age	From	To	Value	[TxFee]
0xdeb2a41a4e...	10724274	1 min ago	0x439d61956bc...	0xaba708b582...	0 Ether	0.000034711
0xc4cb20cfbf2...	10724254	7 mins ago	0x75873edb8a...	0xaba708b582...	0.00000000000012 Ether	0.000046897
0x5a3191c788e...	10724232	13 mins ago	0x75873edb8a...	IN Contract Creation	0 Ether	0.001153706

Figure 8. Transaction fee and block created in step 3.

Note: The left part is the screenshot of transaction fee paid by the vendor; the right part is the screenshot of the record of Ethereum blockchain in step 3.

(4) Step 4: Receive the equipment

When the distillation tower is transported to the appointed place, the procurement team will inspect the quantity and visible damage and the procurement team needs to conduct “receive” action in the system (see Figure 9). The de-

ployed contract will be updated accordingly. In this step, the procurement will need to pay transaction fee to Ethereum for adding a new transaction regarding confirmation of accepting the distillation tower (see Figure 10).

price	0: uint256: 43000
procurement	0: address: 0x75873edb8ab42a0b933bc86b27c7776a1ea7ce3
productName	0: string: Distillation Tower
remaining	0: uint256: 30100
status	0: string: waiting for final payment and ready to install
vendor	0: address: 0x439d61956bc06fab4f3d2c3cdA004bdE6b508D2

Figure 9. The status of deployed contract in step 4

TxHash	Block	Age	From	To	Value	[TxFee]	
0x828edf7c3e5...	10724296	1 min ago	0x75873edb8a...	IN	0xaba708b582...	0 Ether	0.000069135
0xdeb2a41a4e...	10724274	8 mins ago	0x439d61956bc...	IN	0xaba708b582...	0 Ether	0.000034711
0xc4cb210cfb12...	10724254	14 mins ago	0x75873edb8a...	IN	0xaba708b582...	0.000000000000012 Ether	0.000046897
0x5a3191c788e...	10724232	20 mins ago	0x75873edb8a...	IN	Contract Creation	0 Ether	0.001153706

Figure 10. Transaction fee and block created in step 4.

Note: The left part is the screenshot of transaction fee paid by procurement team for confirming acceptance of distillation tower; the right part is the screenshot of the record of blockchain in step 4.

(5) Step 5: Completion of the procurement

In the last step, the procurement team needs to pay the remaining AUD 30100 to the vendor in the system, and the status of deployed contract will be changed to “completed final payment and ready to install” as shown in Figure 11. The

procurement team will pay transaction fee to Ethereum to add the record of this status to the blockchain (see Figure 12). Thus, a total of five transactions are added in the blockchain through the five steps of procurement (see Figure 12).

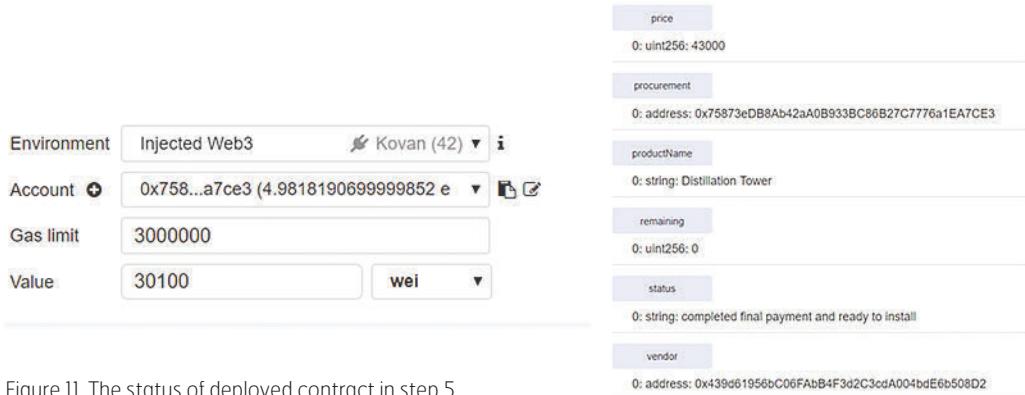


Figure 11. The status of deployed contract in step 5

Transactions						
	Transactions	Internal Txns	Code	Events		
IF Latest 5 txns						
TxHash	Block	Age	From	To	Value	[TxFee]
0x5406cbf4b7c...	10724308	1 min ago	0x75873edb8a...	[IN] 0xaba708b582...	0.00000000000003 Ether	0.000037159
0x828edf7c3e5...	10724296	8 mins ago	0x75873edb8a...	[IN] 0xaba708b582...	0 Ether	0.000069135
0xdeb2a41a4e...	10724274	15 mins ago	0x439d61956bc...	[IN] 0xaba708b582...	0 Ether	0.000034711
0xc4cb2f0cfbf2...	10724254	21 mins ago	0x75873edb8a...	[IN] 0xaba708b582...	0.00000000000012 Ether	0.000046897
0x5a3191c788e...	10724232	27 mins ago	0x75873edb8a...	[IN] Contract Creation	0 Ether	0.001153706

Figure 12. Transaction fee and block created in step 5.

Note: The left part is the screenshot of transaction fee paid by the procurement team; the right part is the screenshot of the record of blockchain in step 5.

4. DISCUSSION AND EXPERIENCE REFLECTION

The blockchain technology has been applied to improve the supply chain in many industries. In this study, the blockchain technology is considered as a useful solution to improve the transparency in the supply chain of mega projects. Although the transaction information is presented in blockchain, the participant's identity is hidden through complex cryptography and represented by their public address, which guarantees the confidentiality of participants to a certain extent. While there is no doubt that blockchain technology is one of

the greatest innovations of recent times, it will take a substantial amount of time before the technology is adopted widely. One of co-authors in this study has ten-year work experience with mega projects as a contract administrator or quantity surveyor, including railway project, large theme park and chemical project. He had worked for over two years in the selected case. In addition, another co-author as an IT engineer has applied blockchain technology in solving supply chain problems for several Australian companies. The scope of work includes civil, steel structure, architectural works, mechanical works, instrument installation works, etc. Through the blockchain system demonstration process, the

research team had discussions and reflected on the difficulties to applying blockchain technology in the supply chain of mega projects, which are summarized as follows.

Firstly, blockchain is not a common sense. Although blockchain has been developed years ago, it is still treated as a new technology because even not all IT researchers completely understand how it works. As a result, it could take a substantial amount of time and cost to train all participants to make them trust in this blockchain based system instead of the traditional system.

Secondly, paying money for every transaction takes additional financial burden. Whenever the users interact with a contract on the blockchain system, they must pay a transaction fee in order to execute their request. The most important thing is that the users are paying the transaction fee regardless of their transaction succeeds or fails. They will lose their money if they enter anything wrong. For instance, once the vendor dispatches the ordered item, the vendor should enter the tracking no. of the delivery. However, if they enter the wrong tracking no., they also paid the transaction fee. In this case, the vendor has to update the tracking no. later, by paying another transaction fee. In mega projects, there are a large number of transactions, resulting in high additional cost.

Thirdly, the contract is not modifiable once it has been created in the blockchain. All details are confirmed once the contract has been deployed in the blockchain, which is unable to change again and again. For instance, according to the real case, a vendor is confirmed during the contract creation stage, it is not easy to replace the vendor, or add new vendors to the contract.

Fourthly, there is a concern about the privacy on the blockchain. The details of transaction information of some materials and equipment need to remain confidential. Some studies have been conducted for preserving privacy on blockchain technologies, such as adding anonymization to the existing blockchain technology (e.g., Confidential Transfers), Coinjoin (joining multiple payments), and Confidential Transactions. However, it is necessary to select an appropri-

ate and effective approach to increase privacy of transactions in blockchain for mega projects.

Lastly, it is not very convenient to use a blockchain system. In order to use a blockchain system, every participant must register an account (e.g., not easy as register a new email) and buy some cryptocurrency. In this study, Ethereum was used (with Solidity Smart Contract), which means every participant must buy some ether (common money on Ethereum blockchain) in order to pay the transaction fee and the product fee (by using blockchain, the users are paying cryptocurrency to buy the product instead of real money). However, the vendors may not be willing to accept and use this digital currency.

5. CONCLUSION

The application of blockchain technology in construction sector is still in its infancy. This study was to examine the feasibility of applying blockchain technology to improve the trust of supply chain in mega projects. The results show that it is possible that blockchain technology can be used to the supply chain of materials or equipment for improving its transparency and traceability. This study sheds lights on the improvement of stakeholders' trust in supply chains of mega projects utilising digital technologies (e.g., blockchain), which is rarely examined by previous studies. Once detailed transactions in supply chain are created in blockchain, they are not falsified, which will improve the trust within the relevant stakeholders. Owing to the nature of blockchain, all users can access to the system to view the actions taken in the supply chain which make it difficult to conceal relevant information in the supply chain. The transparency and traceability of supply chains enabled by blockchain can identify and motivate the good behaviours of stakeholders throughout supply chains, which is also beneficial for fostering and enhancing the trustworthiness in all stakeholders. This is an exploratory study on the application of blockchain technology in the supply chain of mega projects. In the future study, a blockchain-based system for supply chain of mega projects will be proposed and evaluated.

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The Paradoxical Profession: Project Management & Sustainability Contradictions

ABSTRACT

Strong pressures toward ‘sustainability’ have triggered transformations in every aspect of society. Professions as well are undergoing a deep change towards the integration of sustainability concepts into their core values and practices. This paper, taking into account the process of institutionalization of sustainability within project management professional practices, examines the difficult situation in which project managers are expected to work under contradictory sustainability constraints.

In particular, through data from semi-structured interviews with practitioners, we categorize the way project managers make sense of sustainability in a project context. We suggest that the project management profession tends to favour win-win solutions that are typical of the business case cognitive paradigm. However, project managers need to reconcile different conflicting objectives, we suggest practitioners would benefit from the adoption of a paradoxical cognitive frame.

Keywords: The Paradoxical Profession: Project Management & Sustainability Contradictions

1. INTRODUCTION

There are countless studies coupling concepts of ‘sustainability’ and ‘project management’ (PM); so much so it has even become recognised as a new PM school of thought (Silvius, 2017). The academic literature identifies many different reasons as to why sustainability and project management should be considered together, such as the rela-

tionship with project success (Carvalho & Rabechini, 2017; Gareis, Huemann, & Martinuzzi, 2011; Martens & Carvalho, 2016; Yuan, 2017), reputational and ethical factors (Dalcher, 2012; Russell & Shiang, 2012; Silvius, Schipper, & Nedzeski, 2013), and long-term organizational benefits (Abidin & Pasquie, 2007; Brook & Pagnanelli, 2014; Ebbesen & Hope, 2013; Herazo, Lizarralde, & Paquin, 2012; Keeys & Huemann, 2017; Perrini & Tencati, 2006), giving rise to the notion of ‘sustainable project management’ (SPM) (Silvius and Schipper, 2014).

The concepts of ‘sustainability’ and ‘sustainable development’ reflect characteristics that enable the endurance of systems and processes (i.e. replacing resources used with resources of equal or greater value) without degrading or endangering natural biotic systems. The apparent simplicity of these concepts in their abstract definitions contrasts with the complexity engendered when they are considered, hands on, in day-to-day project decisions. The implications of any individual or organizational decision for the natural environment, not only immediately, but also into the future, make things much more complex when sustainability concepts have to be contextualized or detailed into project actions.

In the PM world, when developing a new artefact (such as an infrastructural facility) or a new service, it is extremely difficult to establish a series of objectives that fulfil the abstract definition of sustainability in its entirety, simultaneously meeting environmental, social and economic criteria (the ‘triple bottom line’). Indeed, any decision toward a sustainable objective (e.g. implement sensors to constantly monitor indoor air quality) could be an impairment to another sustainable objective (e.g. cut electricity consumption). Hence, sustainability in projects is often a matter of choice and the

resulting trade-offs have inevitable side effects and create paradoxical or contradictory situations.

Furthermore, project activities, unlike continual business operations, function under strong constraints of time and budget. Project management professionals, working in an environment that by definition is time-bounded, are expected to reconcile typically business-focused objectives with sustainability objectives, which are set in an unspecified but relatively remote future. Consequently, what to prioritize, how to rank objectives, and where to commit the scarce resources are among some of the choices to be made. Moreover, the prevailing of some stakeholders over others with regard to these competing/conflicting objectives is another determinant of the ‘shape’ sustainability will take in a particular project context. To summarize, it is possible to suggest that “sustainability confronts managers with situations in which they need to simultaneously address multiple desirable but conflicting economic, environmental, and social outcomes at firm and societal levels that operate in different time frames and follow different logics” (Hahn, Preuss, Pinkse, & Figge, 2014, p. 466) and this is particularly true for project managers.

In PM, given that the incorporation of ‘sustainability’ concepts is relatively novel, current responses often regard sustainability as something that can unproblematically be integrated within conventional PM thinking and existing frameworks. Indeed, different sets of institutional actors push in different directions, exacerbating existing paradoxes, or creating new contradictions, rather than resolving them (Sabini, Muzio, & Alderman, 2017). Very often a win-win solution is proposed (Carvalho & Rabechini, 2017; Gareis et al., 2011; Martens & Carvalho, 2016; Yuan, 2017) that privileges the economic and emphasises the ‘business case’. In this paper, we suggest that what is lacking in current PM and sustainability research is the adoption of a more critical view consistent with the ‘making projects critical’ research stream (Cicmil & Hodgson, 2006; Cicmil, Williams, Thomas, & Hodgson, 2006; Hodgson & Cicmil, 2016), which has questioned whether prescriptive methodologies, best practices and other propositions have “creatively contributed either to constructive debate in the field or to the resolution of difficulties encountered in practice” (Cicmil & Hodgson, 2006, p. 112). However, a critical evaluation of the purpose of each project is something that may be difficult, if not personally risky, for the individual project manager. Moreover, it

is also necessary to consider the multidimensional character of sustainability. Not only are project managers required to incorporate sustainability considerations into their planning and day-to-day managerial actions, but also the PM profession has to embrace sustainability in a more fundamental way than it has done to date. In addition to this, however, projects need a regulatory framework and system of governance that foregrounds sustainability and, if necessary, penalises unsustainable practices and outcomes.

We therefore suggest that a more critical perspective would help in the analysis of how sustainability is understood and may be achieved within projects. The development of a critical outlook for sustainability within PM should move beyond the traditional business case for sustainability, which emphasises the win-win paradigm. A more critical consideration of the conflict between long-term benefits and the short-term pressures of the project environment could help project managers reconcile the inherent contradictions of sustainability in order to develop new creative solutions to what are highly complex problems.

To begin to address this issue, we frame our work according to literature in the neighbouring field of corporate sustainability, where researchers have analysed the tensions that sustainability creates for traditional organizational strategies (Hahn, Figge, Pinkse, & Preuss, 2010; Hahn et al., 2014; Maletić, Maletić, Dahlgaard, Dahlgaard-Park, & Gomišček, 2014; Van der Byl & Slawinski, 2015; Winn, Pinkse, & Illge, 2012). In particular, we draw on Hahn et al. (2014), who distinguished two contrasting cognitive frames used in this process: the business case and the paradoxical frame. The first frame leads the manager to focus only on the environmental and social aspects that are aligned with economic objectives (sustainability issues are considered pragmatically in conjunction with positive economic benefits for the organization). The second frame leads managers to develop a dual interpretation of sustainability issues, accepting the fact that addressing various “desirable but interdependent outcomes simultaneously leads to a risk of unintended consequences” (Hahn et al., 2014, p. 465). In the paradoxical frame, it is transparent that a solution to one issue could be detrimental to that of another.

In the next section we review current project management literature dealing with sustainability and the arguments for a more sustainable form of project management, suggest-

ing that this amounts to a business case perspective. We then provide some methodological details of the research that generated evidence of practitioner responses to this issue and analyse these responses in terms of the broad themes that emerge. We then present some tentative conclusions and directions for future research.

2. LITERATURE REVIEW

The literature identifies several reasons for adopting sustainable business practices into a project: the ‘moral imperative’ (Silvius et al., 2013a), organizational resilience (Perrini and Tencati, 2006), the organization’s economic prosperity (Gareis et al., 2011), long term performance (Russell and Shiang, 2012), and improving technological performance (Brent et al., 2007) in particular. However, one of the most popular topic to justifications is the economic one. It seems that the consideration of sustainability in relation to a positive economic effect is a common denominator in studies seeking to justify its relevance (Brook and Pagnanelli, 2014; Carvalho and Rabechini, 2017; Dalcher, 2012; Gareis et al., 2011; Herazo et al., 2012; Martens and Carvalho, 2016; Russell and Shiang, 2012; Yuan, 2017). The argument for this resides in the classical economic motive, whereby those who consider sustainability while implementing projects obtain a better economic performance. With this argument, researchers aim to persuade even the more sceptical managers of the importance of sustainability beyond the moral imperative or the ethical considerations (Silvius et al., 2013a). On an even more pragmatic rationale, Ebbesen and Hope (2013) demonstrate that in everyday projects even if the connection between sustainability and success is not completely clear, it is important, especially in certain industries, to consider it in order to ‘stay in business’.

Thus, ‘sustainability’ works as a facilitator influencing simultaneously both strategic and operational levels, making it easier for an organization to reach its objectives. Herazo et al. (2012) demonstrate how, in construction projects, if sustainability is taken as a guiding principle for every project, it facilitates project approval by aligning different organizational levels (from tactical to strategic) and different stakeholders (internal and external). By working as a catalyst in this alignment, sustainability becomes a very important factor to fulfil organizational performance goals. A similar perspective is apparent in infrastructure projects, such

as in the railway sector (Yuan, 2017), where the overall project success is undermined by disparities among stakeholders’ perceptions regarding the achievement of project sustainability. In particular, government agencies focus on the economic sustainability (facing the challenge of driving the local economy in the long term) while environmental protection organizations pay more attention to environmental criteria (ensuring the project is implemented in an environmentally friendly manner). The reconciliation of these disparities and the consequent achievement of sustainable criteria for all different stakeholders is essential to reach project success.

Looking at improvements that SPM could lead to, Gareis et al. (2011) note that benefits of SPM are better exploited when change happens at the level of the ‘core’ processes of an organization (also Dalcher, 2012). This in particular refers to the project management processes: at the start of the project, through continuous coordination, in project control, and in project closedown. The authors argue this happens since consideration of sustainability principles enables organizations to “better cope with the complexity and dynamics of projects” and through a “reduction of project crisis situations, project cancellations and interruptions, and fluctuation of project personnel” (Gareis et al., 2011, p. 64). Therefore, the focus on sustainable aspects of a project (or having a ‘sustainable perspective’), by pushing project managers to consider negative social and environmental impacts, improves the overall project success (Carvalho and Rabechini, 2017).

In describing the contribution of sustainability to project success, another step is added by Martens and Carvalho (2016) in distinguishing between success in ‘project management’ and success in ‘projects’. In this sense, they consider sustainability not necessarily contributing to ‘project management success’ (that is the direct action of the project manager in technically planning project activities) but certainly contributing to the overall ‘project success’ (meeting the initial objective and other benefits planned for the organization as a whole). Striving for sustainable objectives, which are about the perpetuation of the economic, environmental and social benefits of the projects will, they suggest, inevitably lead to the overall project success (Martens and Carvalho, 2016).

Keey and Huemann (2017) suggest how to shape value management, with the consideration of ‘benefit co-creation’ among a project’s stakeholders. They recognize that, for a project manager, to realize benefits in a multi stakeholder environment is very challenging. This led them to develop a framework of ‘benefit co-creation’ with a “continuous process of alignment and realignment, where benefits are shaped in interaction with the multiple stakeholders who bring their own benefits, value creation and risk concerns” (Keey and Huemann, 2017, p.1196).

Another ‘force’ encouraging the adoption of sustainability comes from public opinion. Even if the process of embedding sustainability into a company’s culture is recognized to be ‘immensely challenging’ (Russell and Shiang, 2012), the swing of public opinion has given a strong impetus toward those changes. Many organizations have made a shift toward sustainability, making it a “clear and immediate business driver for their suppliers to develop products and services that are progressively more sustainable” (Russell and Shiang, 2012, p. 2). In practical terms, Russell & Shiang (2012) underline how sustainability has the important benefit of improving brand reputation (innovations addressing world challenges, use with customers) and reducing risks (improved value chain environment, health and safety, incorporation of longer term trends). Therefore, with more than 250 project assessments carried out, Russell & Shiang (2012) claim that sustainability knowledge among innovators is increasing, and that it is providing business management with sustainability overviews of their project portfolio.

In order to make the business case for sustainability, and by doing so underline its values, Gareis et al. (2011) highlight the importance to do it also for projects:

The temporary character of projects contradicts the long-term orientation of sustainability. But projects initialise investments in new products, markets, organizations, or infrastructures. By this projects contribute to realize long-term objectives (Gareis et al., 2011, p. 62).

Therefore, this helps organizations to gain improvements that increase the success of the organization in the long term.

In this research, we challenge this traditional vision based on the business case for sustainability, since it accommodates environmental and social aspects solely when aligned to economic objectives. In this vision sustainability issues are considered pragmatically (and often marginally) only in conjunction with positive economic benefits for the organization and for this reason, it fails to embrace the whole sustainability concept leaving PM in a paradoxical position.

We draw on material arising from a series of interviews undertaken with project management practitioners and those associated with a range of professional project management bodies. We apply a sense-making perspective (Weick, 1979, 1995; Thomas, 2000) in order to help understand how the approaches to sustainability identified in the project management literature emerge from the ways in which practitioners make sense of the contradictory challenges posed by sustainability considerations through the use of specific frames (Hahn et al, 2014).

3. METHODOLOGY

3.1 Data collection

To understand project managers’ assumptions about sustainability, we draw on evidence collected as part of an EU funded project on sustainability in project management. In-depth semi-structured interviews were conducted between May 2015 and September 2016 with 14 respondents holding key positions within six different project management pro-

Table 1. Interviews held with different PM associations key people

Name of professional association	Number of interviews
Association of Project Management	4
Project Management Institute	4
International Project Management Association	1
Green Project Management	1
EarthPM	1
PMI Community of Practice	3

fessional associations and communities of practice, including both former and current project management practitioners (Table 1).

The interviews followed a standard protocol, lasted between 30 and 90 minutes, and were recorded, transcribed, anonymised and entered into NVivo11 for the subsequent analysis. Interview questions were designed to elicit respondents' views on sustainability, the strategic decisions they had been faced with in the context of sustainability, and the issues and obstacles faced with regard to achieving sustainability.

3.2 Data analysis

The coding of the semi-structured interviews followed a grounded style approach (Gioia et al., 2013; Strauss & Corbin, 1998), as we coded following 1st order analysis, "which tries to adhere faithfully to informant terms" (Gioia et al., 2013: 20), and 2nd order "theoretical level of themes, dimensions, and the larger narrative" (Gioia et al., 2013: 20).

Table 2. Emergent concepts and themes

1st order concepts	2nd order themes
Barriers Long Vs short term	Tensions
PM professionals Others	Forces pushing the change
Greenwashing "It can't be one person"	Responsibility
No space for sustainability in my job Reacting: "pushing back"	

4. SUSTAINABILITY CONTRADICTIONS IN PM PROFESSION

From the analysed data, a mounting tension emerging strongly from practitioners' discourse reflects the inherent contradiction between the sort-term nature of projects and the long-term focus of sustainability. How can objectives in a long time horizon be met while implementing a short-term oriented project? 'Long-term' oriented concepts col-

lide with the traditional 'short-term' ones from PM: "the project managers are the exact wrong people to care about the long-term; the exact, incorrect person, because they're focused on getting things done" (interview 13, EarthPM). In the view of another practitioner, the origin of this tension stems more simply from "the fact that people tend to think short term instead of long term" (interview 11, consultant).

This perhaps implies that the project manager is the wrong person to take on responsibility for sustainability matters. However, more critical practitioners recognize that that some responsibility may have to rest on the shoulders of the project manager, otherwise they are:

not recognising that there's anything to do but to get their project done at all costs, because their stakeholders and their sponsors want it done, and that means they're leaving out things like social responsibility; they're leaving out things like environmental concerns, and they're leaving out any long-term concern (interview 13, EarthPM).

In part, this was seen to reflect the fact that most project managers have been trained in a world in which PM was focused only on "two or three techniques. The project manager was glued to his charts and was just looking after the numbers" (interview 14, IPMA) and this implies they are not equipped to deal with sustainability issues.

On the other hand, organizational goals are viewed as more long-term and therefore a possible solution is to tie project objectives with those of the organization: "it does make sense to use the more expensive material, if I change my timeframe, if I latch onto the company's proper objectives, the full objectives, the ones they're telling the world they believe" (interview 13, EarthPM). One can see how the conventional rationalistic frame of project management might lead project managers to view the solution in rationalistic terms, such as 'requirements capture': "[the tension] has also to do with how requirements are capture. If you are capturing requirements only in terms of functionality, costs and time et cetera; or if you are actually considering requirements in terms of sustainability as well" (interview 11, consultant).

Practitioners interviewed reflected on the contradictions emerging in their everyday practices, often viewing this as a barrier to SPM implementation and evident in their dis-

course when reflecting on attempts to implement SPM in their everyday tasks. This seems to arise from a conflict of power over decisions regarding SPM: “there was an example given to me of a factory that sent boiling water out to the river. The pm [project manager] wanted to put a system on the pipe to cool the water before it went out to the river. Who is responsible if his leadership says no?” (interview 12, PMI).

The security of the project manager and their career appears at odds with the pursuit of sustainability through SPM. “I’ve had people tell me that they’re afraid they’ll lose their job if they manage their project sustainably” - interview 12, PMI). The difficulty in demonstrating benefits. This is mainly due to the unpredictability of the outcome:

it’s not an easy decision, and you’ve got to think about it before you do it. When you’re trying to adopt some of the novel activities, such as using the structure as a heat sink, then it’s difficult to predict exactly what’s going to happen. There may well have been tests in laboratories, there may well have been a prototype or been done on a smaller scale, but not quite in this specific situation, so you’re not sure that you’re going to get the return (interview 2, APM).

5. PROJECT MANAGERS REACTIONS TO SUSTAINABILITY CONTRADICTIONS

From the interview data four different types of reaction emerged through the NVivo analysis: (1) greenwashing; (2) “there is no space for sustainability in my job”; (3) “it can’t be one person”; (4) “pushing back”.

5.1 Greenwashing

The concept of ‘greenwashing’ reflects the perception that SPM is often treated more as a tool to support a claim to be ‘green’ than to actually implement SPM practices. Being compliant with sustainability requirements is seen as a good thing for an organization, therefore the practice of ‘greenwashing’ is very a common shortcut to improve organizational reputation:

... they wanted for it to look good when they had visitors. Like you say, it looks good, it feels like...they wanted that sort of feel, and they wanted features in it that made

sense ... we all mentioned sustainability, and yet it wasn’t part of the [formal] requirements (interview 2, APM).

Nonetheless, practitioners’ reflections also pointed at another kind of greenwashing. They condemn SPM when it becomes a lucrative activity with no real references to true sustainability topics:

They literally said, send us a résumé, or CV, give us an example of a green project management you’ve worked on, include three hundred dollars, and here’s your certificate (interview 13, EarthPM). “It’s very American and it’s very... If you listen to him, he’s solved everything, and I don’t believe that’s true (interview 14, IPMA).

5.2 No space for sustainability in my job

Pragmatics and the realities of project life tend to take precedence in terms of practical actions by project managers, revealing a contradiction between espoused sustainability principles and achieved practice. The vision of SPM is not so easy to implement:

I’ve spent most of my time worrying about other types of institutional issue rather than sustainability (interview 1, APM) and “...not in my current practice, no. Currently I work as a project manager for information technology in general. Basically I will put mobile applications and a portfolio of a programme of those mobile applications, and we do not have that sustainability value (interview 7, PMI).

The demands or requirements of clients also appears as a reason or excuse for not pursuing sustainability, despite claims to engagement in SPM: “I don’t think we’ve ever refused anything, because you’d be a sort of sustainable [sic] philistine. I think we would have found that out before” and “if they don’t want sustainability, and we explain how the project could be more sustainable and they don’t want it, then we listen to what they say” (interview 2, APM).

5.3 “It can’t be one person”

This reaction reflects the need for sustainability to be a collective endeavour, whilst the traditional view of the project manager as ‘heroic’ leader steering the project towards completion and success contradicts this shared perspec-

tive. "There is no merit in being right when your boss is wrong" (interview 12, PMI). This implies sustainability within a project cannot be driven by just one person. One respondent summed it up thus: "It's impossible to do anything on a project despite people. The best projects, you do it with them" (interview 2, APM). The need for organizational buy-in was also referred to: "if your company does not approach work in a sustainable manner, it's hard for you to manage your project sustainably" (interview 12, PMI) and "it's an organizational responsibility not just a project responsibility" (interview 6, PMI).

Operating through solo actions is risky for the project manager, as previously mentioned:

Project managers have to deliver an outcome. Not just deliverables, but there has to be an outcome from it, and so it's getting these ideas straight in your head, and then you think of the person who's paying for it and what do you say? 'Excuse me, Mr Client, but I think that your idea for this building is awful because we're not going to be able to maintain it, we're not going to be able to keep it going?' 'Well, if you don't like it, I'll find another project manager.' So the push has to come from everybody (interview 14, IPMA).

Citing the responsibility of other actors was a frequent response: "I think there is responsibility on all people's parts, but the principal responsibility is with the person commissioning the project [and] responsibility for the sustainability aspects of any project lie with the client, because you can only do what the client allows you to do" (interview 1, APM). Although the view seemed widely shared that project managers cannot act alone in implementing SPM, they are still regarded as having a role as a 'catalyst': "most of the people I'm dealing with are people from industries that would instinctively believe they don't have much to contribute to sustainability" (interview 1, APM). In this way, project managers play the role of motivator or educator of other actors toward SPM.

5.4 Reacting: "pushing back"

The final type of response to sustainability contradictions is a straightforward refusal or a push back, particularly when project managers feel the pressures of implementing SPM, but without a clear mandate or clear responsibilities. SPM

can be interpreted as yet another responsibility that adds unnecessary complexity to the project: "don't go giving us another constraint; we have enough constraints already, so leave us alone" (interview 13, EarthPM). This respondent alluded to the paradox that sustainability considerations required project managers to think beyond the bounds of the project and to consider future operations. They would say things like: "leave us alone, what are you guys doing, our field is project management, we turn over a project, period, leave us alone. You are making us think about operations, and that's not our field" and "we also found colleagues who pushed back very strongly" (interview 13, EarthPM).

6. CONCLUSION

Sustainability is a very broad concept and it cannot be successfully introduced into professional project management practices simply by labelling and use of 'sustainability' terminology. Project managers in our sample recognised the contradictions inherent in attempting to address long-term sustainability considerations within the context of relatively short-term project activities. Our analysis leads us to suggest that practitioners make sense of these contradictions through their conventional rationalist project management frames of reference and the professional bodies of knowledge.

Their responses reflect personal needs, such as career success and job security, along with a strong sense of isolation within a much more complex network of actors concerned with sustainability. We heard frequent recourse to the needs of the client and the limits to what any one individual could do. More significantly, perhaps, it seems to explain why sustainability within project management has been identified within the literature as following a primarily economic (rationalist) logic. The cognitive frame used by practitioners appears to be consistent with the 'business case' frame posited by Hahn et al (2014).

Moreover, in line with the propositions of Hahn et al (2014), project managers seem to be emphasising alignment with the needs and demands of other actors, where that can be demonstrated to be of economic value and therefore business value, whether for the project manager's own organization or that of the client or other stakeholders. In practice, therefore, sustainability is a balancing act between the pri-

orities and concerns of different stakeholders; yet this consideration seems largely absent both from academic and practitioner debates, and this lack of clarity precludes further development in this area. The business case frame that is reflected both in the literature and practitioner discourse understates or fails to acknowledge the paradoxical positions it places project managers in.

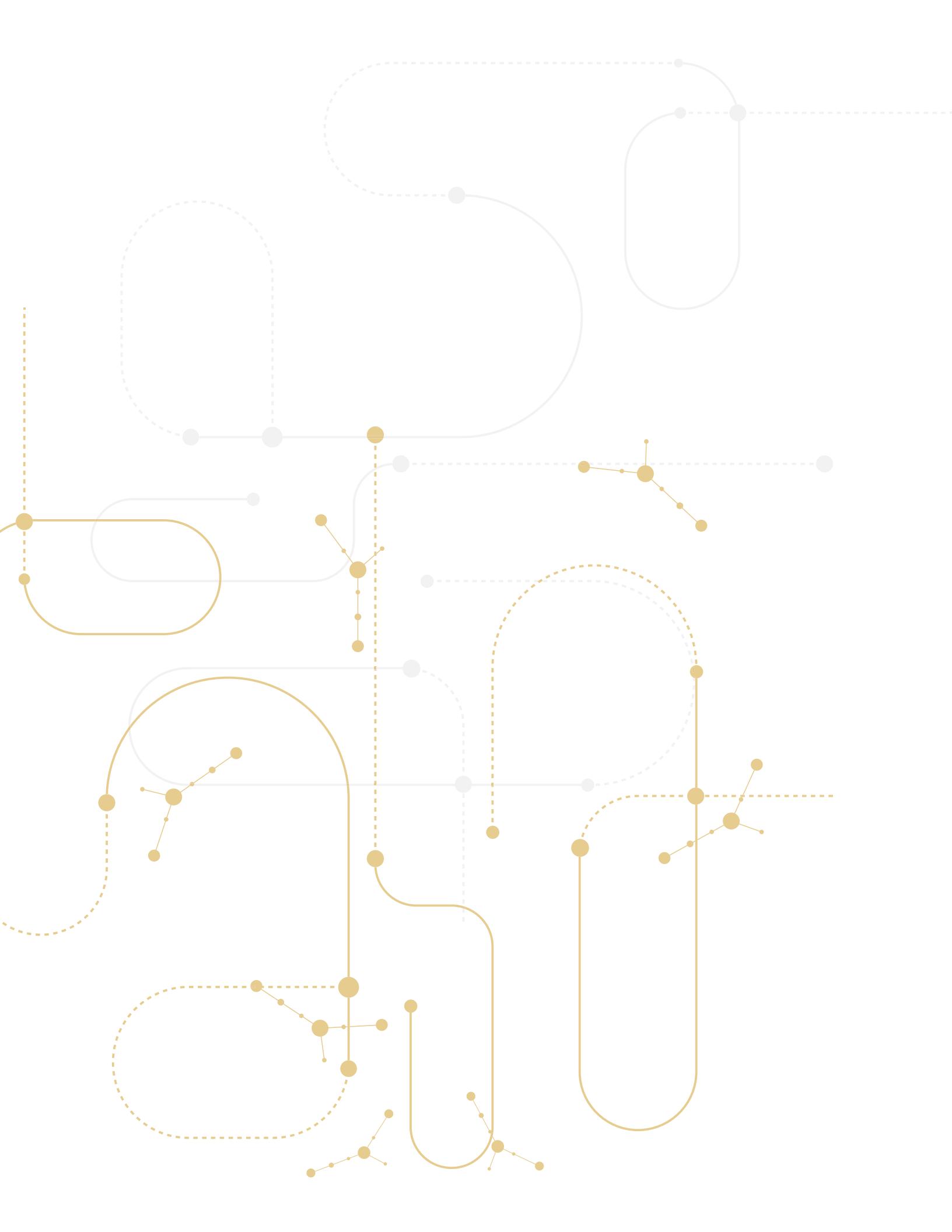
Our preliminary findings seem to confirm the paradoxes created by objectives of sustainability in a conventional business and organizational context. However, the recognition of these emerging paradoxes is a necessary step for the analysis of sustainability contradictions. At the project level individual project managers have to make sense of sustainability objectives in a complex setting of economic, environmental and social demands on their actions and decision making. The pressures experienced by individual project managers inevitably leads to the adoption of win-win

solutions, but these privilege the economic over the other elements of the triple bottom line. A more explicit recognition of the paradoxical frame might enable alternative approaches and solutions to be foregrounded. What is clear is that this needs to be tackled collectively and at project, organization and institutional scales simultaneously. The professional bodies have to reconcile the concept of sustainability with well-established bodies of knowledge and professional practice developed over a long period of time and regulators need to create unambiguous frameworks for business and project activities that provide a level playing field to encourage desirable behaviours and outcomes. How this may be achieved is far from straightforward and opens up an important avenue for future research that will identify how 'sustainability' contradictions unfold in a project management context and how practitioners, professional bodies and regulators make sense of these contradictions in their everyday practices.

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Impact of Trust on Partnership Selection in the Construction Industry

ABSTRACT

Establishing trust among construction practitioners has long been a major concern for construction firms. The temporary or project-based partnerships lead to difficulties in developing mutual trust between organizations or entities. This paper aims to generate an extensive framework to establish trust among project participants in the construction industry. For this purpose, the concept of trust has been presented based on an in-depth literature review. Then, the study categorizes the concept into three categories as affect, cognitive and system-based respectively by considering specific attributes related to cost, time, and quality. An online questionnaire has been sent out to construction practitioners in order to measure the perception of the categories. The survey results indicated that the most important category is a clearly defined contract, where the least important is the political vision. The output of this study is expected to guide construction project practitioners to better understand the impact of trust on partner selection and learn how to prioritize their strengths in order to improve trustworthiness.

Keywords: Partnerships; Time; Cost; Quality; Framework; Critical Trust Factors; Cognitive

1. INTRODUCTION

Construction business requires a wide spectrum of expertise. Division of construction works into packages and team building specific to project needs is usually a feasible solution for successfully managing the construction projects. Hence, it is important to create an environment, where all

partners are motivated, coordinated and work in harmony. In order to maintain the satisfactory level of work ethics, project teams need to develop trust for each other (Lau and Rowlinson, 2009, Sun and Meng, 2009, Yee et al., 2015). Trust encourages members to have faith in the organization and embrace policies and procedures to create the desired working environment (Wong et al., 2008).

Previous studies implied that trust-based relations in the construction projects provide time and cost advantages (Mentzer et al., 2000, Laaksonen et al., 2009, Lloyd-Walker et al., 2014, Cheng et al., 2015, de Campos et al., 2017). A higher level of trust is able to reduce transaction costs in stakeholder-oriented governance (Thorgren and Wincent, 2011). Also, the importance of trust for project success has been studied frequently (Chen and Chen, 2007, Meng, 2010, Rezvani et al., 2016). Trust is a key factor to achieve knowledge exchange, project innovation (Maurer, 2010, Thorgren and Wincent, 2011) and reduce the level of perceived relational risk (Yao et al., 2018). However, there is a knowledge gap for a more comprehensive framework in order to measure the importance of the factors affecting trust in the construction industry.

This study aims to develop a framework for trust establishment among project participants of the construction industry. In this respect, trust is identified as a concept compromised from five categories namely; consistency, honesty, integrity, intent, and transparency in the first stage. Then, an in-depth literature review was conducted to examine “trust” among the construction industry. A summary of the studies concerning partnership selection in the construction industry was presented. As a result, the comprehensive framework was evaluated in three main categories namely

the affect, cognitive and system-based trust. These categories are considered with the concepts that identified the components of the trust, and their affects on time, cost and quality constraints. This evaluation was summarized in three different tables. Finally, a questionnaire was sent out to construction professionals to measure the importance of categories in the framework. This study aims to guide construction professionals to understand the trust term in broader senses and consider the steps to developing trust in their projects.

2. LITERATURE REVIEW

Trust is identified by Rousseau et al. (1998) as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another". However, this definition is not enough for a proper explanation in psychological state, vulnerability, and expectations for the construction industry. A number of studies relating to trust are grouped in different categories such as technical, emotional, informational, technology and finance-related. McKnight and Chervany (1995) identified trust in four measures as honesty, integrity, benevolence, and competence. Brewer and Strahorn (2012) summarized the trust concept in four clusters such as human, attribution, contextual variables, and trust failure. In the scope of this study, a profound literature review related to trust in the construction industry is presented and its relationship with time, cost and quality constraints are considered. Moreover, this study summarizes trust related features in five categories namely the consistency, honesty, integrity, intent, and transparency.

2.1 Trust

Trust is explained as an instrument to overcome the barriers of risk and uncertainty (Gad and Shane, 2014) in the project environment. Trust is easy to lose and hard to build especially in intercompany relationships and it is mostly associated with managerial, technical and organizational capabilities of firms in the industry (Laan et al., 2011a, Woolthuis et al., 2005). Swan et al. (2002) emphasized the effect of trust presence on project success. Wong et al. (2008) implied that the individual's positive motivation towards project outcomes are positively affected by the increase in

trust level. In this study, trust is separated into five main categories to comprehensively explain the concept.

2.1.1 Consistency

Reliability is possible with consistent and strong commitments. Consistency is perceived as the quality of achieving a desired level of performance in the construction industry. Constant follow up of the positive principles, course or form in all circumstances is key to achieving the desired level of quality in a firm. Firms indicating a considerable deviation in their performance levels are less likely to be perceived as trustworthy partners. On the other hand, the level of knowledge is also one important factor in building consistency-based trust with other project participants (Wong et al., 2008). Quality related certifications, a precedent growth rate and a consistent number of workers represent measures to determine the level of consistency. Hence, the consistency of a firm is not independent of its adaptation capability.

2.1.2 Honesty

In the construction industry, it is of utmost importance to find a partner firm considering morality to act honestly in all circumstances. Lilphadzi et al. (2015) revealed that morality and honesty for leadership values positively influence project success. Moreover, catering the relevant information to the parties might appear as communication ability, however, changing measures according to the opponent is considered as a sign for dishonesty. Therefore, objective perspective without deceit and exaggeration in the construction industry might encourage honesty, which is a very important parameter for success in the long term.

2.1.3 Integrity

For a construction company, having the same values and principles at the phases of design, construction and maintenance is a measure of integrity. Integrity might be defined as the state of art relating to unity and strong beliefs. Lewicki et al. (2006) argued that judgments of integrity as well as competence are associated with the knowledge and are shaped in the earlier stages of the relationship. Furthermore, integrity is strongly linked to reliability. Firms showing internal attribution for their failures are considered to have strong corporate integrity (Chance et al., 2015).

2.1.4 Intent

A tainted relationship between construction partners is often caused by the suspicion of the opponent's motives where self-preserving or bad intentions damages trust building. Intent, belief, resources, preferences, needs, and risks are shared within a community (Xia et al., 2015). Behavioral intention reflects a firms' readiness to perform a behavior (Loosemore and Malouf, 2019). Intentions are not enough to complete a project in the construction industry. Hence, firms need to put their good intentions into action to develop trust. The intent is very critical in terms of managing the relations among partners, recovering mistakes, and resetting trust even if it is damaged by different dynamics.

2.1.5 Transparency

Transparency is critical in terms of firms' accountability. Transparency and accountability terms are associated when good corporate governance is present (Akhtar et al., 2000). Transparency is simply defined as the quality of executing work in an open way (CD, 2019). Hence, firms that are considered as trustworthy are transparent in that they share information with their partners in an open manner except for special circumstances. Schnackenberg and Tomlinson (2016) evaluated transparency with accuracy, clarity, and disclosure. This term is expected to contribute to the reduction of corruption and dishonesty in the construction industry (Guo et al., 2019).

2.2 Trust in the Construction Industry

Time, cost and quality constraints are strongly related to the trust definition in the construction industry (Barlow et al., 1997, Bennett and Jayes, 1998, Wood et al., 2002). The interaction experience among shareholders' values, attitudes and emotions construct psychological trust for firms as well as individuals (Jones and George, 1998). Hence, the trust might be simply defined as a bonding investment in the construction industry.

Partnerships are often established where parties need to understand other partners' expectations, needs, and goals in the construction industry. Luhmann (1980) suggested that building relations are easier with building trust first. Common experience, reputation, and working expectations

are important in the stage of initial trust (Campo et al., 2014, Wang et al., 2018). Moreover, trust better develops when the project proceeds to further steps and participants interact in the dynamic model (Ceric, 2015). Harris and Dibben (1999) argued that the achievement of trust in earlier stages promotes the development iteratively. However, trust is fragile (Auger, 2014) and as a result prejudices and disappointing perceptions are leading to distrust. Hence, Hancher (1989) and Sui Pheng (1999) emphasized that establishing construction partnering is more important than setting up contracting relationships. Sako (1992) argued that the main method increasing initial trust is the formalization of cooperation-contracts.

Effective communication and competent performance (Wong et al., 2005), work history and future prospects (Laan et al., 2011b), and mutual trust (Black et al., 2000, Maurer, 2010, Zuppa et al., 2016) are positive influencers of trust in the construction industry. Poor performance and opportunistic behavior of subcontractors negatively impact contractors' trust in subcontractors (Manu et al., 2015). Moreover, it was reported that work attitude and social interaction significantly affect trust (Ding and Ng, 2010). In one other study, Wong et al. (2018) argued the importance of order ability, benevolence, personal propensity and integrity for owners and consultants to maintain trust. Furthermore, a framework was formed to find the importance weights of parameters that identify the trust building concept in the construction industry in Hong Kong (Wong et al., 2008). The study elaborated affect, cognitive and system-based trust definitions and equal importance was obtained where these categories were found mutually dependent. This study extends these three concepts and examines their effect on time, cost and quality of projects considering consistency, honesty, integrity, intent and transparency measures.

2.2.1 Affect-Based Trust

This type of trust is associated with personal feelings and emotional bonds among project participants. Thoughtful and emotional investments are presented to describe affect-based trust development. This type of trust improves the performance and well-being of the teams as well as information exchange and evaluation skills (McAllister, 1995, Wong et al., 2008).

The first column on the trust components of the following table could be interpreted with the following statement.

Accountability with consistency has an effect on the project's cost, time and quality.

Table 1. Affect-Based Trust

Affect-Based Trust		Trust Components					Effect on Project's
Code	Explanation	C*	H*	I1*	I2*	T*	
A1	Accountability	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
A2	Braveness (Not Afraid of Failure)	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
A3	Fairness	✓		✓	✓	✓	Cost
		✓		✓	✓	✓	Time
		✓		✓	✓	✓	Quality
A4	Presence of a Thoughtful Leader	✓		✓	✓	✓	Cost
		✓		✓	✓	✓	Time
		✓		✓	✓	✓	Quality
A5	Same Political Vision				✓		Cost
					✓		Time
					✓		Quality
A6	Supportive Attitude in Hard Times	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
A7	Taking Responsibility (Not Blaming Others)	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
A8	Tolerance and Forgiveness	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
A9	Well Designed Website / Social Media						Cost
							Time
		✓	✓	✓	✓	✓	Quality

C: Consistency; H: Honesty; I1*: Integrity; I2*: Intent; T*: Transparency

2.2.2 Cognitive-Based Trust

Cognitive-based trust is originated from objective information and knowledge developed with the communication between individuals or teams. Formal and informal interactions led to the comprise of knowledge and communication (Wong et al., 2008).

The first column on the trust components of the following table might be interpreted with the following statement.

Ability to learn from mistakes with consistency have an effect on the project's cost, time and quality.

Table 2. Cognitive-Based Trust

System Based Trust		Trust Components					Effect on Project's
Code	Explanation	C*	H*	I1*	I2*	T*	
C1	Ability to Learn from Mistakes	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
C2	Adaptation Capabilities	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
C3	Availability of Lean Construction Applications	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
C4	Best Price	✓	✓	✓	✓	✓	Cost
							Time
							Quality
C5	Cost Estimation Capability	✓	✓	✓	✓	✓	Cost
							Time
							Quality
C6	Construction Machinery Capacity	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
C7	Design Capabilities	✓	✓	✓	✓		Cost
		✓	✓	✓	✓		Time
		✓	✓	✓	✓	✓	Quality
C8	Early Completion Capability	✓	✓	✓	✓		Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality

		✓	✓	✓	✓	Cost
C9	Innovation Capabilities	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
C10	Level of Experience	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
C11	Openness in the Hard Situations	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
C12	Presence of an Effective Leader	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓		✓		Cost
C13	Presence of International Branches	✓		✓		Time
		✓	✓	✓	✓	Quality
						Cost
C14	Prestige Level					Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
C15	Public Offering of Firm's Stocks			✓		Time
				✓		Quality
		✓	✓	✓	✓	Cost
C16	Risk Amount Undertaken Together	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
C17	Same Intentions for the Project	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
C18	Time Estimation Ability	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
						Cost
C19	Timely Completion Capability	✓	✓	✓	✓	Time
						Quality
		✓	✓	✓	✓	Cost
C20	Variety of Financial Resources			✓		Time
				✓		Quality

		✓	✓	✓	✓	Cost
C21	Wide Connections Web	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
C22	Worker Capacity	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality

C: Consistency; H: Honesty; I1*: Integrity; I2*: Intent; T*: Transparency

2.2.3 System-Based Trust

System-based trust is objective and associated with the organizational policy, communication system, and contracts/agreements. Personal or emotional means are not involved in this type of trust. The first column on the trust components of the following table could be interpreted with the following statement.

A competent strategy guiding the firm system have an effect on the project's cost, time and quality.

Table 3. System-Based Trust

System Based Trust		Trust Components					Effect on Project's
Code	Explanation	C*	H*	I1*	I2*	T*	
S1	A Competent Strategy Guiding the Firm System	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
S2	A Member of an International Construction Alliance	✓		✓	✓	✓	Cost
		✓		✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
S3	A Sophisticated IT Support System	✓	✓	✓	✓		Cost
		✓	✓	✓	✓		Time
		✓	✓	✓	✓	✓	Quality
S4	Certified Employees (by PMI, USGBC-LEED)	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
S5	Clearly Defined Contract	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality
S6	Common Service Network	✓	✓	✓	✓	✓	Cost
		✓	✓	✓	✓	✓	Time
		✓	✓	✓	✓	✓	Quality

		✓	✓	✓	✓	Cost
S7	Continuous Information Sharing System (on a regular basis update)	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
S8	Fair Salary Policy for Workers	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
S9	Gain/Pain Share Agreement	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
S10	ISO System at the Firm	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
S11	Manufacturing Ability with Procurement	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
S12	Openness Principles in Data Share	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality
		✓	✓	✓	✓	Cost
S13	Security and Safety Measures	✓	✓	✓	✓	Time
		✓	✓	✓	✓	Quality

C: Consistency; H: Honesty; I1*: Integrity; I2*: Intent; T*: Transparency

2.3 Partnership Selection in the Construction Industry

Construction industry has a fragmented structure. Therefore, different entities need to work together in collaboration and cooperation to finish a project within the intended time and schedule. Behavioral congruence, fair dealing, sensing equity and harmony becomes crucial when firms in partnerships engage in social interactions and resource exchanges, (Ring and Van de Ven, 1994, Pao et al., 2015). By promoting trust, partnering might be identified as an effective tool to alleviate adversarial relationships (Cheung et al., 2011, Wong et al., 2005). Instead of improving the contracting relationship, Hancher (1989) promoted improving partnering and found that “mutual trust” is the most important success factor to maintain partnering relationship

(Cook and Hancher, 1990). Wong et al. (2005) studied the critical success factors of partnering within the prisoner’s dilemma, which suggests the trust cycle can be prompt if construction partners put cooperation before competition and self-interest. They further concluded that partner’s ability for problem-solving, competence and openness are the most critical success factors in trust building. Tang et al. (2006) studied that partnering with incentives could improve risk management and Total Quality Management (TQM). Partners in International Joint Ventures (IJVs) possess compatible technical and managerial skills, financial resources, organizational size, workload and project experiences with strategical fit expected to achieve greater success (Ozorhon et al., 2008). Tang et al. (2009) concluded that partnering can enhance TQM with the existence of a trusted environment, and motivation affects incentives.

Partnering related publications are extensively related to partnering conceptual models, reviews of partnering development and application, potential benefits and barriers to implementation, critical success factors, and partnering performance measurement and evaluation (Hong et al., 2011). The best practice elements might be summarized as partnering workshops, mutual goals and objectives, effective communication and team-building sessions (Sparkling et al., 2016).

3. METHODOLOGY

This study is conducted in two steps. In the first step, an extensive literature review was conducted to identify trust types and their measures. A framework is generated with the help of the literature research and interviews of two industry-professionals who have over 20 years of experience. Then, an online questionnaire was sent out to construction professionals to understand how extensively the factors are identified and applied in practice. The questionnaire also intended to generate the impact of trust on partnership selection in the construction industry. In the questionnaire form, respondents were asked to rate the impact levels of 9 affect-based (table 1), 22 cognitive-based (table 2) and 13 system-based (table 3) factors. The Likert scale (from 1 to 5) is adopted to measure the impacts of questions related to affect, cognitive and system-based trust. Pilot interviews with the two industry-professionals showed that respond-

ents were generally clear with the statements in the questionnaire and could relate the concepts with trust.

A total of 70 online questionnaires were sent out between March and April 2019 to construction professionals with different backgrounds, where mostly engineers are involved. In the end, 32 responses were received resulting in a response rate of 45.7% where the total number of respondents would exceed 30 to allow the use of parametric statistical tests (Acar and Goc, 2011). The questionnaire is distributed to Turkish professionals where most of them are currently living in Turkey (84%). It is crucial to measure the trust factors in the Turkish construction industry that seasonally adjusted confidence index fell drastically (from 77,2 to 49,8) compared to the previous May (TUIK, 2019). Table 4 shows summary statistics for companies and respondents. SPSS version 25.0 is used to generate descriptive statistics. The measurement instrument is regarded satisfactory for all three categories because of the Cronbach's alpha values of affect-based ($\alpha= 0.804$), cognitive-based ($\alpha= 0.864$), and system-based trust ($\alpha= 0.840$) which are over 0.7 which enhances internal consistency measures of reliability. As the number of respondents is below 50 (Razali and Wah, 2011), Shapiro-Wilk test is used to determine the normality of distribution. Our data remained in the limits of +1,5, -1,5 in the Skewness and Kurtosis tests for affect-based, therefore our data is accepted as distributed normally (Tabachnik et al., 2007). For the C5 and S5, where skewness and kurtosis are in between 1,5 - 2,0 the study of George (2011) is adopted to use normality tests.

Table 4. Summary statistics for respondents

Respondents	Sub-Group	n	%	Mean	Median	St. Dev.
Sex	Female (1)	10	31,3	1,688	2	0,471
	Male (2)	22	68,8			
Occupation	Architect (1)	1	3,1	1,969	2	0,177
	Engineer (2)	31	96,9			
Educational Status (Degree)	Associate or High-School (1)	2	6,3	2,750	3	0,762
	Bachelor (2)	8	25,0			
	Master (3)	18	56,3			
	Ph.D. (4)	4	12,5			

	0-5 (1)	16	50,0	1,750	1,5	0,916
Industry Experience (Years)	5-10 (2)	10	31,3			
	10-20 (3)	4	12,5			
	20+ (4)	2	6,3			
	University	8	25,0			
Institution	General Contractor	9	28,1			
	Consultancy Firm	2	6,3			
	Governmental Agency	2	6,3			
	Subcontractor	3	9,4			
	Supplier	1	3,1			
	Design Professional	5	15,6			
	Municipality	2	6,3			
Title	Manager (1)	13	40,6	1,594	2	0,499
	Not Manager (2)	19	59,4			
Specialized Area	Public Works (1)	21	65,6	1,594	1	0,979
	Residential Construction (2)	6	18,8			
	Commercial Construction (3)	2	6,3			
	Other (4)	3	9,4			
City	Istanbul	19	59,4			
	Sakarya	4	12,5			
	Other	9	28,1			

4. RESULTS AND DISCUSSION

Descriptive results indicate that clearly defined contract (S5), timely completion capability (C19), presence of an effective leader (C12), public offering of firm's stocks (C15), design capabilities (C7), security and safety measures (S13), presence of a thoughtful leader (A4) and ability to learn from mistakes (C1) are found as the categories with the highest means, where same political vision (A5), public offering of firm's stocks (C15), a member of an international construction alliance (S2), braveness (not afraid of failure) (A2), well designed website / social media (A9), manufacturing ability with procurement (S11) and a sophisticated IT support system (S3) are found as the categories with the lowest means.

The importance shown from the respondents to the clear identification of contract is in contrast with Kadefors (2004)

who argued that domination of the contract could counteract the mutual trust environment. As Chen and Lin (2018) stated, leadership is a main influencer for project success. The similarity level in between the means of affect (mean=3,89), cognition (mean=4,08) and system-based trust (mean=4,03) complies with the results from the study of Wong et al. (2008), therefore all three categories are in need to be enhanced comprehensively. On the other hand, the less important subjects found in this study such as the importance of similar political view could be associated with the characteristics of the examined country where in India, this is an important trust factor for public-road constructions (Lehne et al., 2018). Another result is that the importance of a sophisticated IT support system is not embraced in the country to establish trust where communication, computer science, and psychology research could be enhanced to improve trust (Oliver, 2019).

Table 5. Summary descriptive statistics

Code	Mean		Std. Deviation		Skewness		Code	Mean		Std. Deviation		Skewness	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic		Statistic	Statistic	Statistic	Std. Error		
A1	4,2188	0,70639	-0,926	0,414	C14	3,9375	0,91361	-0,683	0,414				
A2	3,5938	0,71208	-0,352	0,414	C15	3,2188	1,03906	-0,101	0,414				
A3	3,9688	0,82244	-0,311	0,414	C16	3,9375	0,80071	-0,286	0,414				
A4	4,3750	0,79312	-1,216	0,414	C17	3,9063	0,92838	-0,321	0,414				
A5	3,0625	1,16224	-0,391	0,414	C18	4,2813	0,63421	-1,110	0,414				
A6	4,1250	0,87067	-0,567	0,414	C19	4,4688	0,56707	-0,437	0,414				
A7	4,3125	0,89578	-1,259	0,414	C20	4,0000	0,50800	0,000	0,414				
A8	3,7188	1,05446	-0,622	0,414	C21	3,7813	0,83219	-0,631	0,414				
A9	3,6250	1,07012	-0,853	0,414	C22	4,1563	0,72332	-0,793	0,414				
C1	4,3750	0,70711	-1,277	0,414	S1	4,2500	0,62217	-0,214	0,414				
C2	4,2188	0,79248	-1,252	0,414	S2	3,5938	0,97912	-0,170	0,414				
C3	3,7500	0,91581	-0,269	0,414	S3	3,6563	0,90195	-0,361	0,414				
C4	4,1563	0,72332	-0,793	0,414	S4	3,9688	0,93272	-0,190	0,414				
C5	4,4063	0,87471	-1,545	0,414	S5	4,7188	0,52267	-1,721	0,414				
C6	4,0938	0,89296	-0,772	0,414	S6	4,0000	0,76200	0,000	0,414				
C7	4,3750	0,75134	-1,247	0,414	S7	4,2813	0,81258	-0,576	0,414				
C8	4,0625	0,75935	-0,578	0,414	S8	4,0313	0,99950	-0,479	0,414				
C9	3,9375	0,91361	-0,412	0,414	S9	4,0000	0,87988	-0,303	0,414				
C10	4,3438	0,86544	-1,393	0,414	S10	3,7813	0,83219	0,085	0,414				
C11	4,1250	0,70711	-0,766	0,414	S11	3,6563	0,90195	-0,642	0,414				
C12	4,4375	0,75935	-1,426	0,414	S12	4,0625	0,87759	-0,737	0,414				
C13	3,6875	0,96512	-0,687	0,414	S13	4,3750	0,90696	-1,401	0,414				

At first, the analysis of the survey data revealed that there is no statistical significance between many categories according to tests of Tukey and Scheffe. Also, the regression test gave no significant equational relationships. The relationships found are summarized in table 6 and 7.

Besides, according to the ANOVA test results, 0-5 years experienced attendees gave statistically higher points for "the best price" according to the 20+ years experienced attend-

ees. This could be interpreted with the inexpertness and the direct statistical thinking of young respondents. Also, 0-5 years experienced group gave statistically higher points at "openness in the hard situations" category according to the 10-20 years experienced group. "Openness principles in data share" is also voted statistically higher by 0-5 years experienced group than 5-10 years experienced group. Therefore, the transparency of the works and continuous communication is more important for the younger group to

establish trust. According to the specialized area, tolerance and forgiveness, well-prepared website/social media and innovation capabilities categories are rather highly voted by other type than commercial projects. One interesting result could be followed at the educational status row where so-

phisticated IT support system is significantly voted higher by the associate or high-school degree owners, rather than Ph.D. owners. The groups with (*) sign possess the superiority on the compared group.

Table 6. Significance in the ANOVA tests

		Dependent Variable		Groups to Compare		Mean Difference		95% Confidence Interval	
Respondent Difference	Code	Test	First Group	Second Group	(I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Industry Experience	Best Price	Tukey	0-5*	20+	1,438*	0,490	0,032	0,100	2,775
	Openness in the Hard Situations	Tukey	0-5*	10-20	1,063*	0,360	0,030	0,081	2,044
	Openness Principles in Data Share	Tukey	0-5*	5-10	,938*	0,320	0,032	0,063	1,812
Specialized Area	Tolerance and Forgiveness	Tukey	Commercial	Other*	-2,667*	0,876	0,025	-5,060	-0,274
	Well Prepared Website	Tukey	Commercial	Other*	-2,667*	0,878	0,025	-5,064	-0,269
	Innovation Capabilities	Tukey	Commercial	Other*	-2,167*	0,742	0,033	-4,191	-0,142
Educational Status	A Sophisticated IT Support System	Tukey	Associate / High School*	Ph.D.	2,000*	0,730	0,049	0,008	3,992

Attendees working at university rated "well-prepared website" higher according to the general contractors. Academic staff is more aware of the impact of the digitalization (Bergman et al., 2019) to the trust and upcoming trends than the general contractors. Female respondents gave higher points than their male counterparts in the category of cost estimation capability. Best price, openness in the hard situa-

tions, ability to learn from mistakes and clearly defined contract categories are rated higher by managers according to the non-managers that enhances the managerial subjects possess greater importance for the managers. These four categories have been separated in terms of importance in trust for Turkish construction industry managers.

Table 7. Significance in the Independent Sample t-tests

Dependent	Group 1	Group 2	Levene's Test		Sig.	
			F	Sig	(2-tailed)	
Well Prepared Website	University*	General Contractors	Eq. var. as.	7,166	0,017	0,012
			Eq. var. not as.			0,012*
Cost Estimation Capability	Female*	Male	Eq. var. as.	5,788	0,023	0,086
			Eq. var. not as.			0,027*
Best Price	Manager*	Not Manager	Eq. var. as.	0,007	0,932	0,043*
			Eq. var. not as.			0,059
Openness in the Hard Situations	Manager*	Not Manager	Eq. var. as.	1,733	0,198	0,016
			Eq. var. not as.			0,0318*
Ability to Learn from Mistakes	Manager*	Not Manager	Eq. var. as.	0,31	0,582	0,047*
			Eq. var. not as.			0,076
Clearly Defined Contract	Manager*	Not Manager	Eq. var. as.	17,975	0	0,019*
			Eq. var. not as.			0,043

5. CONCLUSION

Trust is an indispensable key component in construction partnering. Previous studies concluded the importance of trust in project success. In this study, trust concept is separated into three categories as affect, cognitive and system-based trust from the study of Wong et al. (2008) where these concepts were extended and associated with time, cost and quality constraints with tables. In total 44 subcategories are evaluated by the construction professionals according to their importance on the trust in the construction industry. As a result, the highest points were given to a clearly defined contract and timely completion capability. On the other hand, the same political vision and public offering of firm's stocks categories are found as the least important measures to establish trust. Moreover, a well-designed website/social media and sophisticated IT support system got

higher points than these categories that enhance the tendency to digitalization. The differences of groups are measured statistically; managers gave greater importance to best price, openness in the hard situations, ability to learn from mistakes and clearly defined contract for the trust establishment. The transparency is found more important for the less experienced respondents. Also, the results of affect, cognition and system-based trust categories comply with the results from the study of Wong et al. (2008). This study aims to guide construction professionals to understand the trust term in broader senses and consider the steps to developing trust in their projects. One limitation of this study is its relatively local and limited number of responses from Turkish origin. Further study could have a larger number of respondents from different countries and evaluate the results with multi-criteria-decision-making tools.

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European Megaprojects: Managing Contextual Uncertainty through the Stakeholder Management

ABSTRACT

This paper aims at studying the relation between the contextual uncertainty and the project external stakeholders, and to propose an integration of the two perspectives to be able to maximize the efficiency in managing the uncertainty through the stakeholder management. By developing and validating a new stakeholder approach framework and using literature on stakeholder management, a comprehensive frameworks was developed in three steps including stakeholders analysis, uncertainty analysis and guidelines for strategy. The framework then was validated through investigating the political, financial and environmental conditions of two European mega-projects and the results of the adaption of the model were presented. This paper suggests that the external stakeholders are considered source of uncertainty due to their attitudes' dynamism. If they change their position and attitude toward the project then it would be more risky for the project manager to foresee the stakeholders' behavior in order to mitigate the impact of the risks coming from them. This is, however, not adequate to consider the external stakeholders' dynamism in order to capture the uncertainty. There is also the need to consider the complexity of the context. An unexpected change in the context can influence the position of the stakeholder or create some obstacles. The limitations of this article are related to the qualitative nature of the scales used to perform some analysis of the external stakeholders in addition to the practicality of the uncertainty matrix to identify the level of uncertainty.

Keywords: Uncertainty; External Stakeholder; Mega-project; Context

1. INTRODUCTION

Nowadays when managing cross- country infrastructure mega-projects or mega-events the problem is that the context in which the project is placed is undertaken or not properly addressed. For these projects, the external stakeholders are those ones that mostly affect and are affected by the context and its changes, which is the reason why they are considered as one of the most important sources of uncertainty in the planning phase. The context is changing at an ever-increasing pace, thus the uncertainty related is even higher because changes in the political scenario, or economical or environmental one, represented by the correspondent external stakeholder, lead to new risks or opportunities for the project development.

It follows that the challenge for the project manager is to foresee these changes, and implement and plan the project in question trying to use the stakeholder management as a tool to manage the uncertainty, reducing the risks of possible failures, such as delays, cost overruns, lost opportunities, etc. To accomplish and guarantee the success of the planning phase, where we know the uncertainty level is higher and so is needed more attention and accuracy because of the possible protracted consequences all along the future phases of the project, there is the need to understand in depth the influence of external stakeholders in order to maximize the efficiency of the external stakeholder management process.

The project manager should also acquire more information as much as possible about the country(s) where the project is placed in terms of political, economic, social and envi-

ronmental situation in order to be able to foresee on time possible changes or uncertainties, and to act promptly being flexible and capable to adapt to a new scenario. These changes in question are brought by the external stakeholders like political party, economic institutions, environmental activists and so on. Thus, an external stakeholder management process should be, if conducted properly and effectively, first, the tool to manage the uncertainty, and then, an opportunity to improve the project development leading to its success.

According to the existing external stakeholders' analysis we need to understand what would be the best approach that is more integrated with the uncertainty analysis. There is a lack of knowledge, indeed, of how the contextual uncertainty impact on the mega-projects' development and how it is integrated with the stakeholder management.

To fill the gap in the literature and make knowledge contribution, the aim of this article is to study the relation between the contextual uncertainty and the project external stakeholders, and to propose an integration of the two perspectives to be able to maximize the efficiency in managing the uncertainty through the stakeholder management. To make possible this integration, this research presents a structured way (quantitative and qualitative) for the analysis of the external stakeholders to be integrated with the analysis of the context and generate, thus, different scenarios with different level of uncertainty.

Therefore, the outcome of this research is the development of a new integrated approach for the external stakeholders and uncertainty analysis, some guidelines for the possible strategies to adopt in the different scenarios of uncertainty, and some ideas and suggestions for the future framework for an effective stakeholder management. The aim is to help and support the project manager in the planning phase to better manage the external stakeholders' network that can be subjected to changes due to the modifications of the context and due to the high level of uncertainty.

2. METHODOLOGY

2.1. Research Design

The definition of the research and the relative problem to address has its origin in the recognized importance of the context where the geo-political and economic assets are changing so fast bringing a high level of uncertainty and complexity. Therefore, the management of the infrastructure mega-projects, those projects which impact the society and the economic more than others, becomes a difficult and crucial task for project managers.

Once defined the research area, the next step was to identify more specifically the problem to address in order to formulate the research questions that would have led to the starting of the study. The problem identified was concerning the difficulty of the project manager today to cope with the contextual uncertainty, emanating from the contextual factors (political, economic and legal & regulatory factors), and with the high complexity, intrinsic characteristic of mega-projects. The main issue of the project manager is that risk management techniques and tool are not sufficient to manage this uncertainty because the major source is represented by the external stakeholders. Therefore, the missing study and understanding of the contextual uncertainty's impact on the project, together with the inadequacy of the existing tools and techniques of risk management, lead to the formulation of the main research question which drove the whole research:

Main RQ. *How does the contextual uncertainty impact on the development of mega-projects?*

Research question involving the sub-questions:

RQ1. *Which external stakeholders are more influencer in the planning phase of the project?*

RQ2. *Which are the impacts of the external stakeholders' actions and attitudes toward the project in the planning phase?*

RQ3. *What are the contextual factors that influence the complexity of the project?*

RQ4. *What are the major uncertainty issues related to external stakeholders?*

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries of the phenomenon and context are not clearly evident (Yin 1994). Qualitative research and case studies are more oriented towards the process and the relationship between factors and are based on information gathering from interviews, observations, and other documents (Merriam 1998).

2.2. Data collection

The case study started by reviewing all the reports, documents and papers of the selected projects that were public and available because other scholars or researchers had already studied them. To catch the public opinion we used media and articles from the newspaper as well. We then used interviews as the main source of data for the research.

The interviews were conducted by Skype or by phone call and they were semi-structured with a set of open questions, which allowed flexibility in addressing some new issues could emerge during the conversation that were not planned before. Therefore, the managers first clarified some technical information about the project helping me in understanding the influence of the external stakeholders and how they were managed in situation of high uncertainty and complexity, and then they suggested some improvements and advice of strategies to use in managing the external stakeholders with the aim to reduce or manage more efficiently the uncertainty associated.

2.3. Data Analysis

Reaching data saturation, the analysis phase started. The analysis consists of identifying the changes occurred in the political, economic and legal and regulatory context, identifying the impact of these changes with the relative consequences on the project development, identifying the external stakeholders' attitudes toward the projects and their influence according to the eventual change in the context (e.g. government's attitude toward the project when the elections with the change of the political party occurs), identifying the possible uncertainties related to each stakeholder and draw the conclusions. The cross case analysis was then performed to realize how in presence of different

strategies of stakeholder management the related uncertainties were managed and how the project development was affected by the context.

The suggested approach consists of three parts. First was evaluating the importance and influence of the external stakeholders. The second was identifying the level of uncertainty associated to each category of stakeholders according to the level of complexity of the context, and the third one was suggesting guidelines for strategies to manage the external stakeholders. The new approach has been then applied to the cases studied to validate its accuracy and validity.

3. CASE DESCRIPTION

3.1. Case 1: HSR (High Speed Rail) in Portugal

The High-Speed Rail Project in Portugal is a Transport Megaproject of a value of about 15.2 billion € with the purpose to build the high speed rail network for Portugal consisting of 5 links. Earlier, low interest rates, made possible by being part of the Euro zone, fueled an economic expansion that was supported by high expectations regarding future productivity growth and was financed by debt.

The consolidated impact, economy and business, of all the mega-transport projects and other Public Private Partnerships, increased the debt, and made the model of economic and financial global consolidation impracticable, making it a high risk to taxpayers and to the financial sustainability of the Portuguese State. The two milestones in the changes of the opinions were the crisis in 2008 and the sovereign debt crisis in 2010 and the government had two objectives in responding to these events: to maintain the stability of the Portuguese financial sector and to buffer the domestic impact of the crisis.

In the period 2003-2010 different laws were applied to PPPs and in the period 2007-2010 several pieces of legislation were put forward to implement preventive measures (reservation of corridors from incompatible land uses). All these changes caused some delays in the project, but overall the impacts were not important.

3.2. Case 2: EXPO 2015 in Milan

Expo 2015 is the universal exposition, a unique global event that took place in Italy, exactly in Rho – Pero in the north-west of Milan, from 1 May to 31 October 2015. The objective of Expo Milano 2015 is providing the visitors with a unique, memorable experience in terms of culture, education and entertainment, presenting itself as a traditional and innovative exposition at the same time. The EXPO area (1.38 Km²) is divided into Pavilions, accounting for 50% of the space, an external area for the 35% and a green belt for the last 15% (Locatelli and Mancini 2010). The total cost of the project was estimated around 2.254,7 € billion.

The economic scenario in Italy was not stable. In the 2007 the financial crisis with the bankruptcy of Lehman Brothers impacted the Italian economic environment, leading to a more strict and rigid system. After the crisis of 2008, the Italian economy knew a period of stagnation and recession, with a reduction of the PIL by 1,2 %. Moreover, around the 2011, the sovereign debt crisis occurred with the raising of the spread and the distrust and credit crunch for the banks. In this economic environment, the choice to believe in Milan and, in Italy, was a hazardous choice, seen by the majority, but also the chance to release the country.

Expositions, along with various regulations by the BIE aimed at disciplining the competences of the Country hosting the event and the participation of the Countries in the event. Since the event took place in Italy, it remained under the exclusive jurisdiction of the Italian State and, consequently, the applicable rules are those in force in Italy.

The period 2007/2008 was very difficult for the Italian economy. It was seen more as a challenge rather than an opportunity to grow and support the economy. In fact, all this argument became the central thesis supported by local activists and committees against the project because it was considered a disaster from all the point of view. The impacts of these economic changes can be categorized as delays and postponements in the project development because there was the problem of finding other funds, of trying to stabilize the situation and, especially, of containing and opposing the protests of the activist groups against the project.

All the laws and the legislative decrees did not influence the project development raising issues or causing delays/postponements. In case of Mega-events, like an Universal Exposition, the Legal & regulatory environment is often supporting the realization and organization of the event trying to simplify some procedures or allowing particular requests, since the participating countries are coming from all over the world and there is the need of standardization and more control from the regulatory authorities.

4. RESULTS

4.1. Case 1

As a conclusion of the analysis, it has been observed that the context changed a lot in all its environments (political, economic and legal & regulatory). The main critical change was the one represented by the political party who was continuing changing through the project development resulting in a fragmented support to the project. The instability in the political environment lead to big uncertainties in the future of the project.

The external stakeholders opposed to the project highlighted the negative influence on the levels of public debt and possible crowding-out effects of the project by creating a constraint in funds available for private investment. Therefore, the HSR project is a clear example of how the external stakeholders' attitude can have a strong impact on the project, especially if they are characterized by a high level of dynamicity, so they change a lot through the project development (supporting first, opposing then).

This project has suffered from media attention and attack. This is a case where media, even if is not considered a stakeholder group from literature, here can be due to the strong effect on the project outcome. The stakeholders that had greater prominence in social communication were the Government, contractors, opinion makers and opposition parties.

The interview concerning the stakeholders' part was aimed at identifying the most influential stakeholders or stakeholder groups in the project development, the kind of impacts responsible of the importance given to those stake-

holders, the frequency of changing of their attitude toward the project and some free considerations about the stakeholders' management they adopted during the project with some suggestions for a better approach.

From the interview emerged that the most influential stakeholder in the project's development was the Government, as it was emerged also from the analysis of the case study. In fact, the instability of the political context, mirror of the dynamism of the Government, was recognized as the major cause of the problems of the project. The Governments had influence on main constant changes in the scope of the project, in fact, some political decisions such as the location of the main stations, the variation on the type of traffic, etc. had as effects delays in the development phase and some postponement in the stages where to take decisions for the technical evaluation. Therefore, the main impacts related to the most influential stakeholders are delays, postponement and suspension.

The phase in which these kinds of uncertainty showed up was the feasibility study and then continued through the preliminary study. The impact of these uncertainties was defined as high because several changes of scope and several changes in alignments/corridors occurred. Normally political decisions were made for the events that were going to occur, therefore, the uncertainty was managed at a technical level through engineering studies. There was an approach to identify the uncertainty *a priori* and implement a strategy *ad hoc*.

4.2. Case 2

The Expo 2015 is a mega-event characterized by a huge complexity from all the point of views, from the organization, to the stakeholders' management, from the economic framework to the involvement of all the different countries from all over the world. Expo 2015 represents a typical project to understand the strength of a rigorous methodological approach to uncertainty and the need for a mature consciousness at managerial level on these topics (Locatelli and Mancini 2010).

From the analysis of the Expo case, the uncertainty stemming from the context had an impact on the timing of the project, causing delays and postponement of the opening

date. The event should have been officially started in the 2014 and the delay was about 1 year and still, at the opening ceremony, some buildings were under construction. The political and economic environments played here an important role, influencing most of the decisions taken to face some problems that occurred.

Therefore, a good stakeholders' management and a correct engagement plan is fundamental and essential for the successful realization of this kind of mega-events. All the news and information about the bad management of the project, the corruption, the arrests of general directors, and the negative impacts on the Italian economy, could have caused the suspension of the project or a major postponement because without control. Therefore, the support of the public institutions, such as the government, the municipality, the government authorities, the civil society and so on, is the condicio sine qua non of a good success of the project because these stakeholders have the power to direct some public opinions toward a positive view.

5. DEVELOPMENT OF THE FRAMEWORK

The new approach presented in this section consists of three main parts: external stakeholders' analysis, uncertainty analysis, guidelines for strategies. The aim of this approach is to integrate the stakeholder and uncertainty management processes in order to make the project manager able to understand to which stakeholder he has to give more attention starting from the planning phase. This integration is made possible through the consideration of the influence of the context over the project development.

This new approach stems from the awareness of the necessity of integration between stakeholders' analysis and uncertainty analysis because, as clearly stated in the real projects analysed in the previous section, what is still missing in the project management process is a good cooperation and collaboration. The problem of do not foresee on time the uncertainties can result in a difficulty in managing the relationships and the attitudes of the stakeholders that can turn against the project, above all if the communication is not enhanced and ensured by the project manager. The result could be a disaster for the future of the project that can be suspended, as for the case of the HSR in Portugal.

The new approach is explained in the following steps:

Step 1: External Stakeholders' analysis

The first step is the analysis of external stakeholders in order to understand their position in the network in terms of salience and influence's level. Reviewing the literature, the best tool that fits with the analysis is the one proposed by Olander and Landin, (2005), the stakeholder impact index, which in turn is the result of the combination and integration of other tools and indexes in the literature proposed by other authors. The calculation is:

$$SII = Vill \times A \times Pos$$

- (i) the vested-impact index "Vill" (Bourne and Walker 2005)
- (ii) the stakeholder attribute value "A", which is the sum of all the attributes possessed by the stakeholder (Mitchell et al. 1997)
- (iii) the position value toward the project "Pos" (McElroy and Mills 2000)

The vested-impact index is a concept developed by Bourne and Walker (2005) and it consists of the parameter vested interest levels (probability of impact), and influence impact levels (level of impact). The final formula of the index is:

$$Vill = \sqrt{\left(v \times \frac{i}{25}\right)}$$

The vested interest levels "v" and the influence impact levels "i" are qualitatively assessed in a 1 to 5 scale:

- For the vested interest "v" the levels are assigned based on the involvement of the stakeholder in the project which determines its interest.
- The assessment of the impact "i" is slightly more complicated to define in an objective way; therefore, we suggest always a qualitative scale from 1 to 5 but with this level's description.

For the next sub-step we need to calculate the stakeholder attribute value. The stakeholder attribute values "A" is assessed by summing all the weighs assigned to each attrib-

ute (power, legitimacy or urgency). To each attribute is given a weigh between 0 and 1, where the sum of all the three weighs-attributes for each stakeholder has to be 1.

The stakeholder attribute value will depend on the distribution of the three attributes that each stakeholder possesses, showing the relative strength and importance with respect to the specific case. In the infrastructure mega-projects, it was chosen a distribution where more importance is given to the attribute of power because in these projects the stakeholders are more important and influencer if they have more power. We will adopt the same distribution proposed by Olander and Landin, (2005) in his work where p= 0.4, l= 0.3 and u= 0.3.

Before summing the weighs of the attributes possessed by the stakeholder, we need to define which attributes the stakeholder possesses. Now we need to calculate the **position value toward the projects or "Pos"**. The position value is given by assign a numerical value to each of the stakeholder's position toward to projects defined by McElroy and Mills (2000):

- Active opposition: Pos = -1
- Passive opposition: Pos = -0.5
- Not committed: Pos=0
- Passive support: Pos= +0.5
- Active support: Pos= +1

With the assessment of all the three elements is possible to calculate the stakeholder impact index by multiplying each value. Once having calculated the index for each single stakeholder, then is needed to calculate the total stakeholder impact index for evaluating the overall impact of external stakeholders to the project. The formula for the total stakeholder impact index is:

$$SII_{Project} = \sum SII_k$$

Where k = 1 to n number of stakeholder.

If $SII_{Project}$ is positive the project has a favorable stakeholder impact, but if it is negative the stakeholder impact is unfavorable.

At this point the stakeholder impact has been calculated through an index, which is a relative number where the sign is indicative of the favorability/unfavorability toward the pro-

ject. The impact index alone is not sufficient to bring a clear overview of the position and importance of all the stakeholders in the network, therefore a matrix is needed in order to map the stakeholders and give a visual understanding of the real situation.

In the salience/Predictability matrix one dimension is referred to salience of the stakeholders, the other one to the predictability of their attitude toward the project. We suggest using the salience instead of the power, as in the matrix of Newcombe (2003) because the power is not always the most important attribute.

To assess the salience of the stakeholder we suggest using the stakeholder classes defined based on the attributes possessed, therefore, if a stakeholder possesses just one attribute, it will have lower level of salience compared to one who possesses more than one attribute. Once defined the stakeholder classes, to each class is given a numerical value in order to create a scale according to which is possible to map the stakeholder in the matrix for the "salience dimension". The stakeholder's classes are defined by Mitchell et al. (1997) dependent on the distribution of stakeholder attributes and in the following Figure 1 is clear how the classes are assigned.

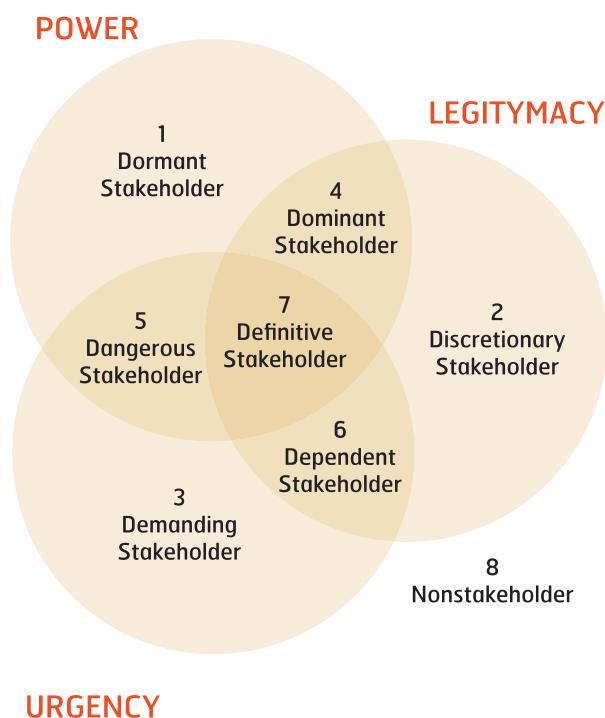


Figure 1. Stakeholder classes (Mitchell et al. 1997)

Once we have identified the class the stakeholder belongs to, the next step is to assign a numerical value to each class defining the "value of the salience" in the matrix. The value has been assessed in the following way, giving priority to the attribute "power" which for these projects focus of this thesis has been considered the most important among the others.

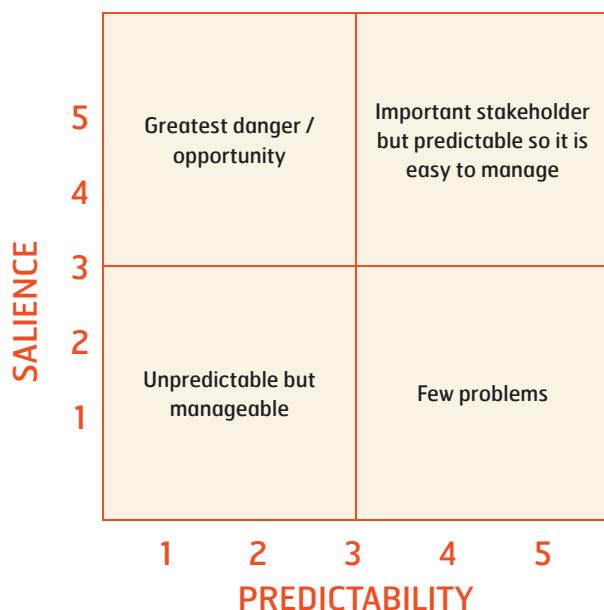


Figure 2. Salience/Predictability matrix
(adapted from Newcombe 2003)

Step 2: Uncertainty analysis

The next step is the uncertainty analysis. We suggest an integration between the stakeholders' analysis and the context analysis since it was found, in the case study analysis, that the influence of the context in mega-projects is very important and that the uncertainty, stemming from the context, is often undertaken, thus the project manager has difficulties in managing external stakeholders.

The objective of this analysis is to assign to each stakeholder's category a level of uncertainty in the planning phase, to facilitate the job of the project manager in foreseeing the possible uncertainty stakeholder-related, so thus to focus more attention and effort in managing those stakeholders, with the final aim of mitigating the uncertainty through the right strategy. In fact, the context is a fundamental element to consider when taking decisions in the strategies to man-

age stakeholders. Because sometimes the changes in the context lead to uncertainties, which are impossible to manage if seen with delays.

Therefore, we suggest using a matrix with two dimensions, the dynamism of the attitudes of external stakeholders, and the complexity of the specific environment related to the stakeholder we are considering (if the stakeholder is "local government" then we look at the complexity of the political environment as "context". In this way, each stakeholder is classified according to the specific context he/she belongs to.)

Adapted from Daft, (2008) where there is a discussion about the environmental uncertainty the organizations have to deal with, this matrix explains that the dimensions are both related to the environment, the rate of change in factors in environment and the number of factors in organization environment (second dimension). To adapt this matrix to the cases, we change one dimension to create the integration between the stakeholders' analysis and the context analysis with the aim to identify the level of uncertainty to each combination.

The first dimension is the dynamism of the attitude of stakeholders, referred to the frequency of changes in their positions and attitudes toward the project. The value of this dimension is assessed qualitatively in high or low since is not easy to quantify the dynamicity. Therefore, we consider "high dynamism" when the stakeholders' attitudes change frequently, because for some reason or events they pass from supportive to opponents easily. The second dimension is the complexity of the context. If we are considering a specific stakeholder, then we need to refer to the specific environment it belongs to. For instance, if we want to consider the stakeholder "local government", then we have to look at the complexity of the political environment.

The Dynamism/Complexity matrix in fact, by combining the two dimensions, creates four different scenarios and each of them is characterized by a specific level of uncertainty. To consider the two steps (external stakeholders' analysis and uncertainty analysis) as a continuum, then the previous classification of stakeholders in the Salience/Predictability matrix should be reported in this matrix, with the same visual representation of balloons. In this way, the integration is made very easy and we can classify each stakeholder in a different quadrant of the uncertainty matrix.

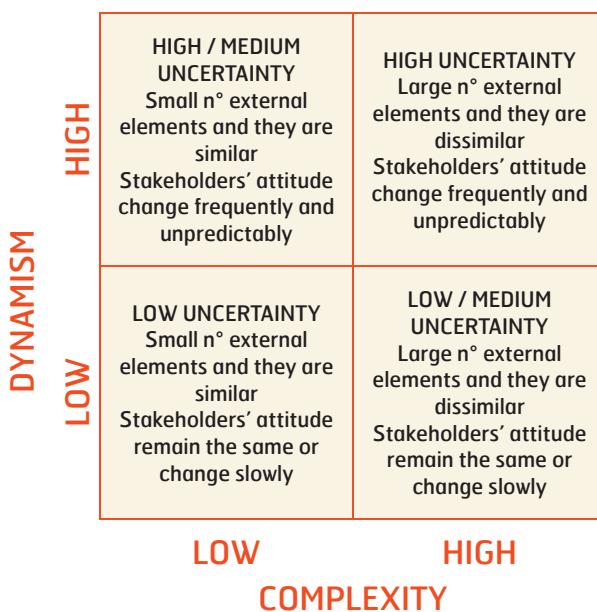


Figure 3. Dynamism/Complexity matrix for Uncertainty assessment (adaptation from the uncertainty matrix in complex environments in the organizations (Daft 2008))

Step 3: Guidelines for strategies

The guidelines of this last step should be investigated more in depth in order to formalize new effective strategies in the stakeholder management. The whole approach aims at improving the decision-making process in the planning phase for the reduction of the risks and uncertainties that impact on the project development and to improve the project outcomes, thus guaranteeing the project success.

After the project manager has completed the first two steps of the approach and has assigned to each stakeholder a level of uncertainty, he has to take decisions on how manage the stakeholders, taking into account the priority rules.

From the uncertainty matrix four scenarios are proposed:

High uncertainty: High complexity of the context and High dynamism.

The suggestion strategy is the flexibility, and in some cases, even the resilience, due to the high need of ability of adaptation to the changes of the context and of the stakeholders' positions toward the project.

High / medium uncertainty: Low complexity and High dynamism.

Here the suggested strategy is the one of reducing the dynamism, thus make the stakeholders' attitude more predictable. The tools could be a strong engagement of the stakeholders in local activities with the aim to gather information about their attitudes and the positions toward the project, a strong communication plan to inform them about the project and try to guide their opinions toward a positive direction of supporting the project.

Low / medium uncertainty: High complexity and Low dynamism.

In this case the uncertainty is more referred to the changes in the environment because there so many external elements the increase the complexity. The suggested strategy is to reduce the complexity of the context

Low uncertainty: Low complexity and Low dynamism.

The suggested strategy is to strengthen the relation with the active supportive stakeholders in order to ensure always a big support and, on the other side, to maintain stable the relationship with passive supportive/opponents because they are not acting directly, and to weaken the relationship with the active opponents trying to make them change direction.

6. APPLICATION OF THE MODEL TO THE CASES

6.1. Step 1

For the first step in both cases, it can be useful utilize a table, proposed by Olander in his work, in order to clearly visualize all the necessary information for calculating the stakeholder impact index.

Table 1. External Stakeholders' impact index calculation for HSR and EXPO

Stakeholder	A										VII				Pos				SII			
	P		L		U		v		i		C1		C2		C1		C2		C1		C2	
	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Government Authorities	X	0.4	X	X	X	X	X	0.4	X	3	X	2	X	0.5	X	0.5	X	0.1				
APA	0.4	X	0.3	X	X	X	0.7	X	2	X	3	X	0.49	X	0.5	X	0.18	X				
Municipality	0.4	0.4	0.3	0.3	X	X	0.7	0.7	2	4	2	5	0.40	0.9	0.5	1	0.14	0.63				
Media	0.4	0.4	X	X	0.3	0.3	0.7	0.7	4	4	5	5	0.90	0.9	-1.0	1	-0.63	0.63				
Government	0.4	0.4	0.3	0.3	X	X	0.7	0.7	5	5	5	5	1.00	1	-1.0	1	-0.7	0.7				
Local Community	X	X	0.3	0.3	0.3	0.3	0.6	0.6	3	3	4	3	0.70	0.6	-1.0	-1	-0.42	-0.36				
E. O.	X	X	0.3	X	0.3	X	0.6	X	4	X	4	X	0.80	X	-0.5	X	-0.24	X				
Regulator and Local Authority	X	X	X	0.3	X	X	X	0.3	X	2	X	2	X	0.4	X	0.5	X	0.06				
Local Activists	X	X	X	0.3	X	X	X	0.3	X	3	X	3	X	0.6	X	-1	X	-0.18				
Civil Society	X	X	X	0.3	X	X	X	0.3	X	2	X	2	X	0.4	X	0.5	X	0.06				
Total																			-1.67		1.64	

It is clear from Table 1 that how the Stakeholder impact index of the total project is negative (- 1.67), therefore the stakeholders' influence is unfavorable. The application's results of the first part of the analysis is coherent with the reality because if we consider the stakeholders "government" and "media" we find the highest values for the attribute value ($A = 0.7$), the highest values for the vested-impact index, which means that these stakeholders not only had a great interest in the project but also the impact was high with important changes and consequences on the project development, and the position value is -1 in both cases. Therefore, the stakeholder impact index is -0.70 for the "Government" and -0.63 for the "Media", we can do two considerations.

The first consideration is about the sign, since it is minus, it corresponds to the opposition of the stakeholder toward the project. The second consideration is about the absolute value, which is higher compared to the one of all the other stakeholders. The index then, gives an objective description of the influence of the stakeholder adding more information respect to some other analysis tools and it is strong for classifying the stakeholders' categories to whom give more attention.

In **Case 2**, The External Stakeholders' impact index is a positive value of +1.64 and different considerations can be made. A positive value means that the stakeholders' influ-

ence over the project is positive, therefore the project was supported almost from all the stakeholders, with active actions from some of them, and with a passive support from others. The most important stakeholders, again, are the "Government" and the "media" because they have a stakeholder impact index of +0.63 both. The difference between these two actors is in the attributes possessed and in the vested interest impact index, higher for the Government. In

this specific case of a mega-event, the considerations are slightly different respect to the ones done for a transportation mega-project. In fact, for a mega-event like a Universal Exposition, the Government decide the go/no-go of the project because it has to support the application and request for being the hosting country of the event, since it impacts the economic, social and political environment of the country.

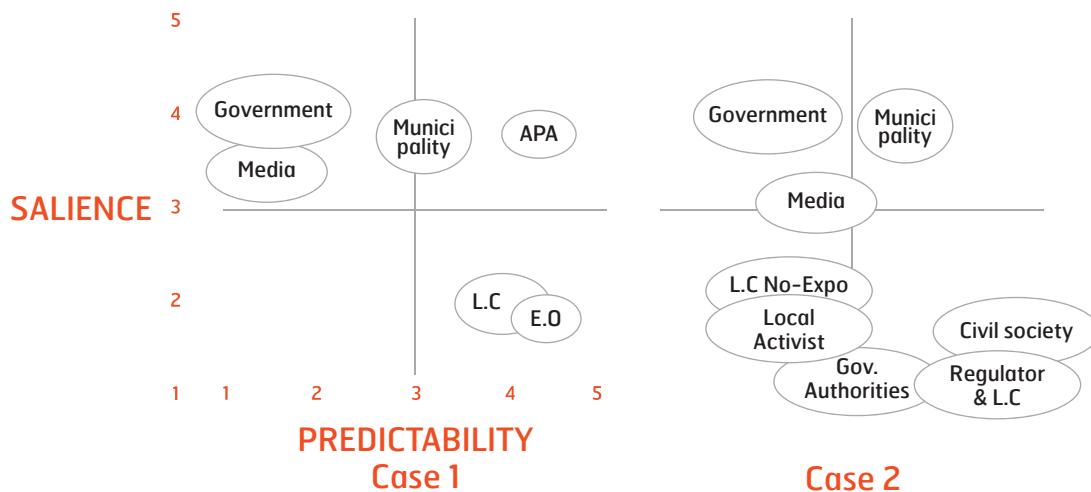


Figure 4. Salience/Predictability matrix for HSR and Expo

Looking at Table 1 we will realize that also the Municipality in this project covered an important role having the stakeholder impact index of +0.63. The Municipality is considered a Dominant stakeholder together with the Government, differently from the Media, a dangerous stakeholder. Expo 2015 was not impacted by the Media with a strong campaign against its operations. Of course the public opinion got access to some information about corruption, a bad management, waste of resources and other negative implications, but it was not enough to stop the project. The position of the Media is +1 because it supported the project, through especially the social networks, the social contests, etc. in an active way. The Media cannot be passive. In Case 2, two stakeholders played the role of the antagonist, strongly opposing the project with several actions such as violent protests. The Local activist group of Black Blocks destroyed the city during the opening ceremony in order to try to create problems for the organization. The calculation of the total stakeholder impact index is important because it gives an overall view

of the stakeholders' network's attitudes and influence over the whole project.

6.2. Step 2

For both cases now the further step is to combine the information taken from this matrix, the predictability of the stakeholders' attitude, with the complexity of the context. The predictability of the salience/predictability matrix is renamed as "dynamism" in the uncertainty matrix, because, even if the two terms are addressing the same concept, in this case the focus is more on the frequency of the change of their opinion. The uncertainty matrix applied to the case is illustrated in Figure 5.

For **Case 1** From the uncertainty analysis, it emerged that, as clearly stated in the previous analysis, the two most important and influence stakeholders are Government and Media and they are in the quadrant characterized by high level

of uncertainty, so they require the attention of the project manager with high priority. The Municipality is positioned in the High/Medium uncertainty level because, even if the relative environment is not complex, then, compared to the other stakeholders such as APA, Local Communities and Environmental organizations, it changed attitude at least once, or it was not completely unified in the supporting or opposing position toward the project, but anyway at a lower extent compared to Government and Media.

Looking at the dynamism dimension, we should find the exactly situation we had in the salience/predictability analysis because we derive the dynamism from the previous matrix, while for the complexity dimension we have to analyze the relative context considering all the influential factors and then map the stakeholder in the right quadrant.

This approach helps, first, to visualize the importance of the stakeholders in the network, so in this case it was clear that government and media had the priority in the attention of the project manager. And then, thanks to the uncertainty matrix, the project manager can classify the stakeholders based on the complexity of the context and the dynamism of their attitudes placing them at least in an uncertainty level. Doing this pre-analysis, the project manager can have some guidelines in where direct more effort and attention because it works as an alert system. When the uncertainty is high, then the alert is high and consequently the next action is the implementation of specific strategies, that should be the 3rd step of the new approach.

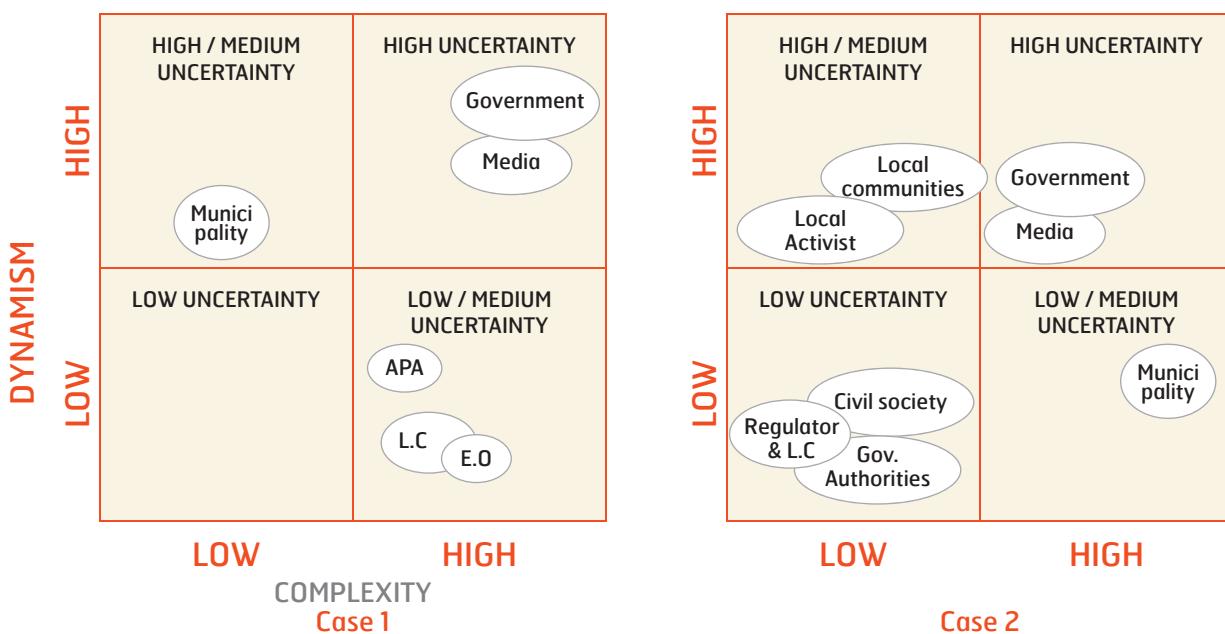


Figure 5. Uncertainty Matrix in HSR and Expo

The uncertainty matrix applied to the Expo case gives a clear overview of the levels of uncertainty that can be assigned to each stakeholder. If with the previous matrix we were only displacing the stakeholders to understand their importance and influence on the project, here we also add important information, which is the complexity of the context. For instance, if we take the stakeholders "government" now it is

clear why it needs attention, even if, in the salience/predictability matrix, its predictability was low because all the different political parties at the power supported the project. The project manager should give more attention to the government because the complexity of the political environment is extremely high. In fact, in the description of the case, it was clearly shown the instability and ferment of the politi-

cal context characterized by several elections and not all of them were conducted regularly and democratically.

Therefore, the highest value of uncertainty can be assigned to this stakeholder. The media is in the same quadrant of the government because the complexity of the environment around, socially and politically speaking, was very complex that could lead the media to become against the project. The activist groups, local communities & committee and the local activist group Black Blocks, have a "high/medium" level of uncertainty because the complexity is low. They could be dangerous stakeholders if not under control, due to the violence in their protest that can lead to physical damages, besides the indirect implications.

In the low side of the matrix we find all the other stakeholders that are considered not a threat because they have a low level of uncertainty, so easy to manage and easy to predict. The municipality has a "low/medium" level of uncertainty because the complexity of the political environment was so complex in Italy at that time; therefore, it represents a stakeholder to monitor. For the Expo case, the application of the approach shows how the complexity of the context can determine the level of uncertainty and not only the dynamism of the stakeholders' attitude. This is a more reason why there is the need to combine the stakeholders' analysis with the complexity dimension of the context, otherwise the risk is to lose some important information.

This tool of the uncertainty matrix gives a real power to the project manager who can, not only classify stakeholders according to their level of uncertainty, but also build a strategy to monitor the situations and prevent negative implications and events.

7. CONCLUSION

Infrastructure mega-projects and mega-events are considered *mega* because the size is *mega*, the total cost is *mega*, and the scope is *mega*. *Mega* is just defined as unit of measurement that reminds to something more than big. There are no easy ways to manage perfectly and successfully these kinds of project, because uncertainty and complexity are two intrinsic characteristics that require more attention, effort, accuracy and all the other elements that make

the outcome of a project a success. This article focused, on purpose, on this theme of the uncertainty and complexity, due to the centrality and the importance of the theme in an era in rapid change as the current one. The analysis of the case studies and the interviews we could conduct to get insights from the real experience "on the field", led to some important considerations.

The attention to the context in which the project is performed has been undertaken in these years, focusing more on new tools and techniques for a better risk management or stakeholder management. The biggest mistake was the one to consider all these processes as independent and not integrated as a unique system that manages the whole project. If the stakeholder management is not integrated with the risk management, then a correct implementation of the mitigation actions or strategies cannot be completely successful, because there is missing the link between the stakeholder, source of some risks, and the risk itself.

We moved the focus from the risk to the uncertainty because now it is more important and efficient to be able to foresee the uncertainties rather than the risks. Which is the reason why of this shift? The reason why lies in the fact that a mega-project starts already with a level of uncertainty. Therefore, the project manager needs to anticipate the future risks by addressing the uncertainties. An uncertain event, being uncertain, can be transformed into a risk or into an opportunity, or it can never occur during the project. This is the reason why there is the need to anticipate the events, identifying as soon as possible the uncertainties related to the project. Also with an opportunity there is the need in fact to be prepared, because otherwise there could be the risk to lose the opportunity, due to incapacity of managing the opportunity or, even worse, due to incapacity to identifying on time the opportunity.

In this article, we define uncertainty as "*a condition where there is lack of information needed to understand and define which could be the event that may occur if a change happens due to internal or external factors. The event, thus, is considered unexpected because not even planned and expected to occur in the execution phase of the project. Being the nature of the event uncertain, then, if the event occurs, it could have positive or negative impact on the project development*

With these assumptions concerning the importance of the uncertainty and the integration with the stakeholder management process in a unique system, the importance of the context in which the project is performed is clear. The context is becoming more and more important due to the changes and the frequency of these changes that occurred in the last years and are going to occur. Therefore, the uncertainty stemming from the context must be addressed by the project manager as a prerequisite to obtain the success of the project. This analysis should be done then in the early stages of the project, in the planning phase, because, if the uncertainties are correctly identified in this phase, then it is easier and there is more time to implement actions and preventive strategies. The ability of a project manager is the one to prevent negative actions, when it is possible, or to face them in a success way. Therefore, the uncertainty analysis should help him in achieving this objective.

From the analysis of the case studies and the interviews, what emerged as important elements characterizing the uncertainty, are the dynamism of the stakeholders' attitude toward the project and the complexity of the relative context. In fact, the external stakeholders are considered source of uncertainty due to their attitudes' dynamism, if they change frequently the position and attitude toward the project, then is more uncertain for the project manager to understand and foresee their behavior in order to keep them under control.

But only the external stakeholders' dynamism is not enough to address the uncertainty, there is the need to consider the complexity of the context. If a stakeholder is almost predictable since he does not change so often the position and attitude toward the project, but the complexity of the relative context is high, then an unexpected change can influence the position of the stakeholder or create some obstacles. In fact, in the Portuguese case study the main factor was the dynamism of the attitude of the external stakeholders that changed frequently their position, in addition to the complexity of the environment; whereas in the Italian case

study the main element determining the high uncertainty was more the high complexity of the context. These findings helped us in proposing an approach that could gather this information and proceed with an almost structured way divided in three steps with the final aim to define a level of uncertainty for each stakeholder's category in order to understand the correct strategy to adopt.

The limitations of this approach could be finding in the tools used and in the information needed to make all the analysis. For what concern the tools used, the limitations are related to the qualitative nature of the scales used to perform some analysis of the external stakeholders, and to the practicality of the uncertainty matrix to identify the level of uncertainty. The reality is always different from the theory, because more complex and complicated to understand, therefore, it is difficult to represent it in a simple way by simply mapping the stakeholders in a matrix. This tool in fact, wants to be a valid helper for the project manager to direct his/her attention to some stakeholder groups/categories without the arrogance to work perfectly. Every time a project manager uses some theoretical tools, he should interpret the results and try to give them a mean, knowing all the conditions around that could not be taken as parameters or variables. Therefore, the approach here described is called approach for this purpose, to suggest a different way more structured to the project manager to address better the theme of the uncertainty.

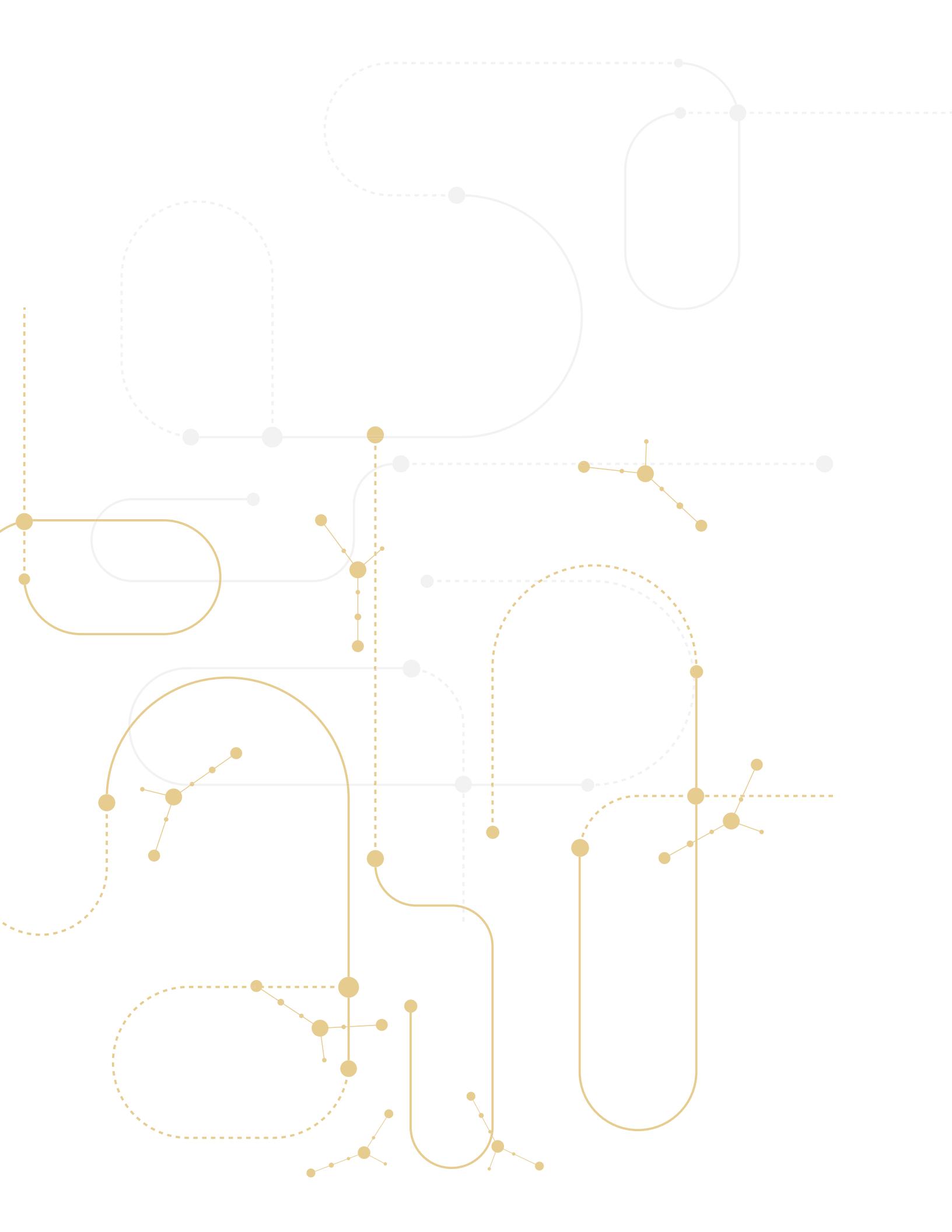
For what concern the information needed, this is a known limit for almost all the theoretical models, tools, approaches, etc. Even if the nature of this approach is more qualitative than quantitative, the information needed to perform well the analysis is not of secondary importance. Therefore, there is the need to implement a good and strong information system because the project manager has to cover all the information gaps to know as much as possible in order to do a more robust analysis and to lower the uncertainty stemming from the lack of information.

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II.

Trust and Project Performance



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A Multi-Level Competencies Framework for the Successful Delivery of Major Infrastructure Projects

ABSTRACT

Successfully executing major infrastructure projects is economically critical for Governments to build civil infrastructure for sustainable growth of increasingly dense urban areas. In the construction industry, projects continue to fail at an alarming rate. One contextual factor contributing to this alarming failure rate is the lack of competencies to manage increasingly complex major infrastructure projects. Recent literature has explored how "soft" project management practices, such as collaboration, learning and adaptation can enhance project performance. This is in contrast to conventional, or "hard" project management practices, such as control, planning and reducing uncertainty, which are currently used to deliver these types of projects.

In a qualitative study, based on explorative interviews with project managers overseeing major and megaprojects in Australia, we have been able to identify a set of multi-level competencies requisite for this role by considering the key challenges encountered by project managers during the delivery of these complex projects. The findings indicate that behavioural emphasis and "soft" project management skills and competencies are increasingly important.

This paper contributes to the growing literature on examining the development and effectiveness of project managers' competencies and skills in managing major infrastructure projects in the construction industry. The research presented in this paper should inform researchers in developing empirical studies relating to this important topic area.

Keywords: Major Infrastructure Projects; Project Governance, Skills and Competencies, Project Manager, Project Success

1. INTRODUCTION

New infrastructure development is becoming increasingly complex which in many ways presents challenges and risks for project managers/leaders. Identifying and dealing with a set of challenges and risks effectively will require new competencies for project management of large infrastructure development projects. Through this research, we explore the challenges faced by project managers in the context of construction and infrastructure development projects in Australia and identify the essential competencies and skills required to overcome these challenges. Our approach to defining project success builds on the widely known iron triangle criteria (Atkinson, 1999). Additional factors for success such as stakeholder satisfaction, current and future impact, and project efficiency, for example are also included. The new set of competencies and skills are identified by reviewing the literature on the factors that challenge the process of delivering major projects by project managers, and provides a base for understanding the competencies and skills required.

Research has identified two levels of project success: 1) project management success, 2) product success (Bacarini, 1999). The former relates to delivery and the latter relates to the overall outcome of the project. Accordingly, project management success is typically "measured at the end of the project against success criteria, such as internal efficiency, ...[and]... typically cost, time, and quality" (Joslin & Müller, 2015, p. 1377). In major infrastructure projects, project management success is not very common. Flyvbjerg (2014) attributed this to issues ranging from complex interfaces involved in major projects to lack of deep domain experience of project managers executing them; and from

changing project scope at different stages of its lifecycle to involvement of multiple stakeholders with conflicting interests. Technological and design changes further add to the risk of project management failure, particularly when project managers lack the necessary competencies and skills to effectively leverage such changes. In other words, the lack of competencies and skills to manage the project would risk project success. For this reason, Joslin and Müller (2015) argued that competencies of a project manager are integral to project success.

In this paper, we argue that evaluation of project management success requires a look beyond the conventional criteria for project success. Rather, we need to develop an understanding of an emerging set of risks and challenges associated with project success. Changing technology (and the associated drive to digitize and innovate), and the requirement for new infrastructure to be sustainable and environment friendly, are pushing the boundaries of project management success further. Hence, the need for project managers to upskill in order to remain competent when managing contemporary infrastructure projects.

This necessitates the significance of obtaining an insight into the key challenges faced by project managers in the contemporary infrastructure development environment to ensure they are trained on the right set of skills to develop competencies for successful project delivery. In this paper, we start with an overview of the literature to advance the understanding of the key challenges faced by project managers executing major construction and infrastructure projects. The key themes from the literature in this area were then used to develop a template for interview questions. The interviews were then conducted with experienced project managers to obtain a deeper insight into the nature of challenges faced when delivering major construction projects and the skills used to overcome them. Specifically, this paper reports findings of the interviews of project managers with more than 15 years of experience delivering Victorian infrastructure development projects in Australia to answer the question:

What are they key challenges in major construction projects? And what sort of competencies and skills are required to overcome them to ensure project success in future?

In so doing, this paper contributes to the growing literature on examining the development and effectiveness of project managers' competencies and skills in managing major infrastructure projects in the construction industry. It is intended that the research presented in this paper will inform both practitioners and researchers on this important topic area.

2. REVIEW OF THE RELEVANT LITERATURE

Understanding of project challenges in construction/infrastructure industry is fundamental to supporting project managers in the acquisition and development of their skill-set and behavioral competencies. An in-depth review of the literature focusing on key challenges that affect project managers in large construction and new infrastructural projects is conducted by Ahmad et al. (2019). Their main findings are annotated below.

2.1 Schedule Delays

Many construction projects get delayed, some by a few days only while others are delayed by a year or more. Essentially schedule delays represent "a situation where a construction project does not come to completion within the planned period" (Kaliba, Muya, & Mumba, 2009, p. 524). Research on the causes of delay have attributed these to financial difficulties, not seeking the required approvals on time, changing working conditions, project design, transportation related difficulties, shortage of materials, excessive bureaucracy, coordination problems, and shortage of equipment and tools on site (Ahmed, Azhar, Castillo, & Kappagantula, 2002; Alaghbari et al., 2007; Long et al., 2004). Further, it has been revealed that schedule delays are often complemented by cost overruns.

2.2 Cost Overruns

Major infrastructure projects often make headlines in the public media "for being poorly managed and often over budget" (Ahiaga-Dagbui, Love, Smith, & Ackermann, 2017). Cost overrun is another significant and repetitive problem associated with major construction projects. Cost overrun refers to the increase in the amount of money required to construct a project over and above its original budget (Kali-

ba et al., 2009). While project cost estimation activities are performed during different stages of the project execution (e.g., planning, tendering, contracting), the initial cost estimates have been found less reliable compared to the estimates obtained during later stages. Poor planning, use of unreliable methods to estimate project costs, modifications made to initial project scope/plan, economic rate of inflation, engineering uncertainties, and use of inexperienced administrative staff are some of the key reasons attributed to cost overruns (Ahmed et al., 2002; Kaliba et al., 2009).

2.3 Poor Coordination

The risk of poor coordination is high in projects involving international collaborations and public-private partnerships. Poor communication among varied groups, bureaucratic relationships and conflicting stakeholders' interests compound these problems. In the absence of local expertise, construction projects draw requisite expertise from countries with different work cultures, standards, practices and communication preferences thus adding to the project's complexity and coordination problems.

Similarly, when a large number of contractors and sub-contractors are involved in a project, the relationships between the parties involved as well as the transfer of information between them becomes complicated. This further adds to coordination problems and also increase the risk of disputes between the parties, particularly in instances where their communication means were ineffective (Long et al., 2004).

2.4 Contractual Problems

Whilst a fair and transparent bidding process and pre-qualification of tenders ensure that the tenders are given to competent contractors, selection of inexperienced contractors and sub-contractors and mis-managed contracts with them cause contractual problems (Long, 2004). Moreover, inefficient contractors can negatively affect the work of other parties involved in the project.

2.5 Inadequate Assessment and Project management of Project Risks

Project risk, defined as an uncertain event that affects the achievement of project objectives, needs to be closely monitored and carefully managed to successfully deliver

large construction projects. In the view of Nketekete, Emuze, and Smallwood (2016), the risks could be internal (e.g., design issues, labor disputes) or external (e.g., natural hazards, political changes) to the project.

2.6 Poor Stakeholder Project management

Stakeholder project management is a recognised approach for building strong and positive relationships with the project's stakeholders (Mok et al., 2015). Since major infrastructure projects are likely to involve a large and diverse group of stakeholders with varied interests in the project, project managers can face stakeholder project management associated challenges. For example, in terms of identifying the groups, their specific needs, and their impact on the project. For example, a mega construction project in China was delayed by a year due to a legal dispute relating to the project's ecological impact with a stakeholder group. (Mok et al., 2015). Biesenthal, Clegg, Mahalingam, and San-karan (2018) similarly consider public and media scrutiny as an "Arena of Controversy" in the megaprojects area. When megaprojects are open to public eye, success criteria become misrepresented, power and politics affect project management, and external agencies distort priorities (Patanakul et al., 2016).

2.7 Conflict Project management

Given the project's complexity and involvement of diverse group of stakeholders, there is a potential that the project may influence the community life and people's relationships in negative ways. This results in conflicts. Poorly managed conflicts contribute to delays in project completion and cost overruns, and may invoke litigation proceedings (Long et al., 2004).

2.8 Poorly Managed Change Processes

The infrastructure sector is currently experiencing a speed of change significantly faster than it has ever seen before (Heunis, 2016). Major construction projects are often associated with a range of changes from project scope to design, that occur somewhere between their initial planning to final implementation stages. A poorly managed change process can severely disrupt project success. An important category of change is associated with technology. In fact, technology is a major driver of change in infrastructure in-

dustry. Current trends towards digitization provide a major source of change. For example, Building Information Modelling is transforming many processes involved in executing the project. Likewise, semi-autonomous construction equipment has automated many jobs that were previously done manually during the construction process.

2.9 Building Information Modelling (BIM)

BIM has been defined as “a set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the building’s life-cycle” (Bryde, Broquetas, and Volm, 2013, p.). Through its holistic nature, it allows for the electronic input of information and geometric modelling, as well as other processes that enhance project management success (Bryde et al., 2013). It can be used to improve stakeholder collaboration and reduce the required documentation time, hence ensuring a project’s success (Bryde et al., 2013).

Another challenge exists with the emergence of ICT, whereby new technologies often have difficulty fitting within current practices (Froese, 2010). It has been suggested that the reason for this is that current practice in project management de-emphasizes the interdependencies between tasks, whereas the emerging technologies are aimed at collaboration and integration of tasks (Froese, 2010).

2.10 Big Data

The infrastructure industry generates massive amounts of data given its growing use of technology (e.g., BIM). This is termed as Big Data, defined as “the ability to process large amounts of data and to extract useful insights from data” has a growing application in the construction industry (Bilal et al., 2016, p. 500). The growing use of technology is also associated with challenges. For example, research by Jacobsson and Linderoth (2010) on the utilization of digitized survey showed: “The construction workers’ representative complained at a number of production meetings that the workers needed the survey measures for the progress of the work. On one occasion the digitized survey was even blamed for the workers not getting enough drawings, even though the architect’s firm was responsible for the heavy delays in their delivery” (p. 18-19).

In view of the technological disruption, the future of project management success remains uncertain unless project managers are competent with the use of new technologies.

2.11 The New Agenda of Sustainability

Sustainability is considered as an emerging dimension of project success (Moehler, Hope, & Algeo, 2018; Hope & Moehler, 2014; Alvarez-Dionisi, Turner, & Mittra, 2016; Buehler, Buffet, & Castagnino, 2018). According to the “triple bottom line” concept developed by Visser & Elkington (1999), sustainability is about aligning economic, environmental and social aspects with a set of sustainability principles. Since the industry consumes a large percentage (up to 50%) of non-renewable resources (Willmott Dixon, 2010; Ametepey & Kwame, 2014). According to Guo et al. (2014), “The construction site and construction wastes of large infrastructure projects, particularly road and tunnel projects, are likely to impose environmental and associated social impacts. Environment-related effects on surrounding livelihoods and the ecological and urban systems can be a delicate issue to deal with” (p. 817). Moreover, rapid urbanization and the steady wave of technological change in the construction industry are associated with disruption and unsustainability of the natural environment.

Accordingly, project managers need to be conscientious of the environmental impact of the resource used. Project management success now requires sustainable development practices (Hope & Moehler, 2014). Individual standards related to sustainability practices such as Green Project Management Certifications have been developed to fill this gap in project managers’ competency domain (Alvarez-Dionisi, Turner, & Mittra, 2016).

Further, in terms of sustainability, project managers should carefully consider their procurement options and utilize those types of materials that are associated with ecological benefits rather than ecological costs.

2.12 Tackling Unethical Behaviour in the Industry

Research highlights a bad reputation of architects, quantity surveyors and contractors in the industry when it comes to ethical conduct (see also, Bowen, Akintoye, Pearl, and Edwards, 2007). Bowen et al. noted a range of prevailing

unethical behavioral problems such as corruption, bribery, fraud deceit, misinformation and dishonesty in the South African industry. According to these authors, the industry “suffers from unfair tendering practices, as well as over-claiming and/or withholding payment for service delivery” (p. 631).

Project management success requires effective tackling of such unethical conduct. Ethical procurement has been described as an approach “to ensure that products are purchased from supply chains that have undertaken ethical trade” (Mustow, 2006, p. 13). This highlights that project managers should procure all construction material in a responsible manner thus developing ethically sustainable capabilities to ensure ethical procurement of materials throughout the construction industry’s supply chain. For example, the UK industry conforms to the ‘Green Guide to Specification’ for the procurement of construction materials. This guide allows “specifiers of construction products to assess the level of environmental impact of those products” (Mustow, 2006, p. 14).

2.13 Corporate Social Responsibility

The notion of the corporate social responsibility becomes relevant from the sustainability perspective of the industry as we consider the potential damaging effects of construction activities on the natural environment. Corporate Social Responsibility (CSR) has been defined as “corporate policies and actions that go beyond the organization’s economic interest and aim to affect stakeholders positively” (Ng, Yam, & Aguinis, 2018, p. 2). The construction industry has been associated with the depletion of natural resources (Mustow, 2006), which mandates the industry’s need to incorporate CSR initiatives in the form of environmental protection and community building. Ulutaş Duman, Giritli, and McDermott (2016) argue that “many companies in this industry are having difficulties in integrating their social, ethical and environmental concerns into their operations and stakeholder interactions” (p. 219).

2.14 Occupation Health and Safety (OH&S)

When it comes to OH&S, the construction industry has a questionable record, perhaps because working on a construction site is not considered as safe as working in an of-

fice environment. For this reason, Fang, Chen, and Wong (2006) have termed the construction industry as the “dangerous industry”. However, the growing application of technology is now making the nature of construction work and construction jobs safer. Technology can also make it more convenient for workers to adhere to safety standards.

3. OVERCOMING THE CHALLENGES

The challenges facing project managers in the construction industry has far reaching consequences requiring the development of new and enhanced competencies and skills to support the successful delivery of projects.

Project management bodies and associations have set out competency frameworks for the project managers involved, which emphasize both hard and soft skills. By applying a balanced combination of competency and skills, project managers can overcome the challenges associated with projects. Takey and de Carvalho (2015, p. 785) defined competence as the “ability to mobilize, integrate and transfer knowledge, skills and resources to reach or surpass the configured performance in work assignments, adding economic and social value to the organization and the individual”. The competencies relate to both personal (e.g. leadership; communication style, teamwork skills) and technical aspects.

The foregoing overview of the literature implies that successful delivery of large construction projects is not an easy task. We need to understand how project managers respond and react to these varied challenges. The aforementioned literature review sets a foundation to understand the key challenges in delivering major construction projects through answering the research question of what sort of competencies and skills are required to ensure future project success.

4. METHOD

This paper is part of a study that examines the key challenges faced in the delivery of major projects to advance knowledge on competencies for project success. From this project, one paper (i.e. Ahmad et al., 2019) is centered around a review of the literature whereas the present paper focus-

es on the challenges and competencies of project managers in the context of Victorian infrastructure development projects in Australia. Focusing on the qualitative analysis of explorative interviews, this article explores both the probing for initial relevance and emerging themes. Accordingly, we conducted, at the time of submitting this paper, two face to face interviews with experienced project managers working in the context of Victorian construction industry to obtain a clear picture of the challenges and project managers' responses to these challenges. Each interview lasted from 35 minutes to 1 hour in duration. Our interviewees comprised both male and female participants who have obtained a Master's Degree in Project management. On average, they had above 16.5 years of project management experience, which involved at least 10 major construction projects. The core themes from the literature review (e.g. technology, sustainability, OH&S and risk project management) were used to develop the interview questions.

The interviewees were provided with a copy of the explanatory statement together with a consent form to complete. The interviews were digitally recorded, transcribed in verbatim and the digital transcripts were subjected to template analysis of the data. Template analysis is an approach that involves thematic analysis of qualitative data such as inter-

views. The analysis involved developing a coding scheme or a template, which contains themes that were identified on the basis of the literature and organized in a structured manner (King, 2012). Specifically, we applied a hierarchical coding scheme based on dual focus of our research: challenges and competencies, forming the overarching themes in the hierarchy. The literature suggests that emerging challenges relate to change (i.e. scope and schedule related), technology, sustainability, stakeholder project management, risk project management and OH&S when executing project delivery in this increasingly complex environment. This was followed by questions on the competencies and skills requirements to overcome such challenges.

5. FINDINGS

At the beginning of the interviews, we requested the project managers (herein reported as Project Manager A and Project Manager B) to report the extent to which selected themes (see Table 1) have challenged them on a scale ranging from not at all, to moderate to high. Table 1 presents their responses. This was followed by questions requesting in-depth answers relating to the study's core themes that were subjected to template analysis.

Table 1. Structured responses from interviewees

Challenges	Degree (A)	Degree (B)	Challenges	Degree (A)	Degree (B)
Schedule Delays	High	M to High	Coordination problems	Moderate	High
Cost concerns/Financial problems	Moderate	Moderate	Communicational problems	Not at all	Not at all
Scope Changes	High	High	OH&S issues	Not at all	Moderate
Conflict	Not at all	Moderate	Procurement issues	Moderate	Moderate
Labour Issues	Not at all	Moderate	Technology	High	High
Managing stakeholders' Expectations	Moderate	High	Environment	Not at all	Moderate
Contractual problems	Not at all	Moderate			

Table 1 demonstrates that schedule delays, scope changes, managing stakeholders, their coordination, and technology appeared to be of moderate to high concern for project managers in Victoria. The rest of the interview questions were structured around the core themes as discussed earlier. With the hierarchical coding scheme for data analysis, the results are reported in two major themes: 1) key challenges faced by project managers of major infrastructure projects and 2) key competencies required for a project manager.

5.1 Key Challenges

The findings of the key challenges follow the research template that was used to structure the interviews and the analysis of project managers' answers revealed themes as reported below:

5.1.1 Changing Schedule and Scope

Changing schedule and scope was recognized as a highly challenging issue by project managers particularly as more and more projects are executed in a live environment, with clients expecting a quick delivery. According to Project Manager A, *Scope changes I'm seeing more of a trend now particularly as projects get funded and often there is a couple of years [gap] before it is delivered and finished. Technology changes and clients needs change, so there are always going to be scope changes.* Similarly, Project Manager B also discussed scope as a challenge: *I think also the other significant problem is one of understanding what you're doing and the scope and the objectives being clear before you begin.*

5.1.2 Technology

Technology appeared as another highly emerging challenge faced by project managers as the notion of technology usage varied across the project team members, from routine administrative tasks such as document storage to more complex activities of project design and development (e.g., BIM): *As a project manager one of the biggest tools we use in technology is your kind of platform based knowledge sharing like an Aconnex I think that's kind of the industry standard these days* (Project Manager A).

BIM is another commonly deployed software application in infrastructure projects. However, Manager B disclosed that BIM poses some challenges to project managers: *It's another thing that we haven't really got our mind around and BIM is the classic, no one really know what they mean when they ask for BIM. So, it can be as much a problem as solution.*

Information overload was identified as another key challenge associated with technology: *There is so much information available and everything that it can sometimes distract you from what you are trying to do as a project manager and often you find that PM's coming from a far more technical background will love those sort of things because they'll delve into the detail but I think one of the challenges is really pulling yourself back out of that detail and working at that project still as a whole of project approach and not getting weighed down by the information that's available* (Project Manager A).

Finally, participants acknowledged that the Victorian government is spending billions of dollars on infrastructure development. Yet presence of a robust digital engineering framework is still a challenge in this context, which is required for a robust execution of major projects: *You get everyone in a room and no one can agree on what that [digital engineering framework] looks like. Even at the framework level beyond the, well so what do we expect from the project participants then so the engineers, the contractors the operations maintenance people, the ITS around that and how does that all connect is a real challenge right now* (Project Manager B).

This shows that a technological challenge may relate to developing a coordinated understanding its use.

5.1.3 Sustainability

In the project managers' experience of the government's projects, they found sustainability is a highly prioritized issue: *Certainly over the last decade I think sustainability has certainly become more of a norm I think that kind of 10 years ago it was a nice to have you needed to demonstrate that you were sort of looking at it it's now very much entrenched in how you deliver projects.* Yet, they disclosed

that the notion of environmental sustainability itself challenges project managers: they should *Know what are your materials doing, what are you using and what's recyclable, how can we engage with different marginalised groups, how can we design buildings that are going to be more inclusive of people* (Project Manager A).

The interviewees shared that CSR is making the Victorian infrastructure projects more complex: *So at the moment on our large project we've just finished the first draft on the environmental effects statement which covers not just flora and fauna as the most basic I guess but subsurface water and hydrogeology and cultural and human factors and business impacts they're all a part of it* (Project Manager B).

5.1.4 Stakeholder Project management

Stakeholder project management was an apparent challenge for project managers given the diversity of the stakeholder groups involved:

Because we work in infrastructure development, our stakeholders are always the same and they are everybody. So going through a process of understanding who the key ones are and who the drivers are and how we manage them individually or specifically is a key [challenge] (Project Manager B).

Good communication strategy appeared to be critical for an effective stakeholder project management: *I think sometimes that is part of our job is having those tough conversations with your stakeholders and there is no substitute for sitting in front of someone. I think written communication is really important for decisions so talk to them first and then follow it up in writing because if you pair everything back you are still contracted to do a job and there are contractual implications of decisions and they need to be tracked* (Project Manager A).

5.1.5 Risk Project management

The implementation of risk project management strategy was identified as a challenge that can affect the successful delivery of major infrastructure projects. Project Manager B suggested the following approach to risk project management: *We'll have multiple risk registers that will be update-*

d ADHOC and infrequently, and then also I think that typically we're pretty poor at taking what we've learnt from any risk review... don't see many instances where project managers pour through their risk register and update their risk project management plan or their control in response to that

Further in the Victorian industry context, Project Manager B shared that risk project management is "poorly done as a discipline", despite regular dedicated risk workshops, "the outcomes from them are pretty static".

5.1.6 OH&S

Keeping herself and her people up-to-date with the changes in OH&S domain was recognized as "one of the biggest challenges" and "something that is continually evolving in terms of safety onsite" by Project Manager A who shared her challenging experience as follows: *I worked on Margaret Court Arena [a major tennis court] for instance and we had a real safety issue after it opened where the glass in one of the big house lights shattered because of heat loading and so then you need to then go well my builder is not on site anymore or they are or what do I need to do and how do I make it safe for the people who are now frequenting this venue because it's still sits with you.*

5.1.7 Other Challenges

Resources: This was recognized as a challenge because "Resourcing: it is having the right person at the right time available" (Project Manager B).

Financing Issues: Although project are constrained by budgets sometimes, in terms of financial issues, Project Manager B considered "Budget concerns tend to be more an outcome of other issues and challenges more so".

Conflict: In terms of conflict, labour was considered as particularly challenging "in terms of probability and capacity".

5.1.8 Key Skills and Competencies

Whilst discussing the key challenges, project managers also shared their views on skills and competencies required to offset such challenges. In the following, we report the findings in the light of core themes discussed earlier.

5.1.9 Managing Changes in Schedule and Scope

This would require proactive thinking from project managers in terms of educating the client at the start that things are likely to change during project execution: *From both their perspective and from the design perspective and what that means to your end result and your finances and obviously your schedule with scope changes.* For this reason, project managers need to engage in contingency planning and plan for change. Success to this end is *about managing your stakeholder expectations that if you want more it takes more time or if you want to deliver it with no shutdowns that it's going to take more time so for me success is about in terms of schedules sitting your client down having a difficult conversation with them and agreeing a new schedule* (Project Manager A).

A successful changes process is conducive to flexible approach, quick adaptability and agility of project managers.

5.2.2 Managing Technology

In our interviewee's view, managing the technology would require able project managers with knowledge and analytical skills as new technologies are fast emerging. In their view, successful projects rely on a good project manager who can define the requirements and make sure those technologies meet that and then take the project on the journey to deliver on it.

Specifically, in terms of skills, Project Manager A emphasized: *Obviously the computer skills side of things is huge. The other thing I think is there needs to be an analytical side of what you're doing because this information is being produced by one party you know on a project you need to be able to analyse what information is coming at you and decide whether this is in fact a) What we are wanting for the project and b) whether it's really being driven by sort of an objective that one part of the project team is trying to meet and whether that meets with the objective of the whole of project".*

Project Manager B shared similar thought: *New technologies that are emerging and advancing and the ability to stop and check and assure that that actually meets the projects requirements is really important.* But he reflected on project managers' skills beyond technical skills: *What I'm*

interested in is you showing me that you understand the project, then we'll make sure that what we use to manage it aligns with that. So managing for the context of the project not the basis of the technology. Because these technologies are emerging so fast outside [the project environment].

5.2.3 Managing Sustainability

Both project managers acknowledged the environmental challenges as many of their projects bear a significant impact on the environment, particularly in terms of energy and consumption of other resources. So they considered having a deep understanding of sustainability associated challenges particularly in terms of the ethical implications relating to the resource use. For sustainability project management, Project Manager B advocated *having an environmental team as part of our business certainly helps. We can turn to the contaminated land guy and ask a question...*

5.2.4 Managing Stakeholders

As project managers work with a diverse group of stakeholders, they emphasized on high-quality communication skills and showing empathy. Empathy is important to understand your stakeholders and their needs: *I think the first step in any stakeholder project management is actually looking at who you are talking to it's about going into the business and learning about what their day looks like and what their daily life looks like because that will impact how they are able to engage with you on a project.* Similarly, good communication skills are required as communication is important to engage with them: *how I communicate with them [stakeholders], my view is always sitting in front of them is going to be the best way of getting to know your stakeholders* (Project Manager B)

With their communication skills, project managers can keep the stakeholders engaged *because often project management don't see the intricacies of the challenges that have led to getting this project up* (Project Manager B). They can also tailor the information shared to make it more effective.

The analysis of interviews also highlights the optimal frequency of communication with stakeholders: *I think if you aren't talking to your stakeholders in a 2-week period. They get nervous I think that you have your structured*

you know fortnightly or when meeting but you might have some informal catch ups on a weekly basis with your key clients. This is because to project managers' silence may imply things are going well, but for them this makes them feel a bit unsteady about what decisions are being made without them (Project Manager B). Thus, frequent casual communication along with formal communication is important.

5.2.5 Managing Risk

The interview analysis revealed that running a risk workshop with the project's design team, contractors and clients during initial stages of project development is an important approach to manage risk: *That's your first step to identifying the big stuff, but also making risk a conversation that isn't a scary one often risk involves actually interfacing with different project partners. It's not just about safety risks, it's about what's the risk our design team doesn't perform (Project Manager A).* According to Project Manager B, although major projects generally involve a dedicated risk project management team, project risk project management could still be an intuitive process: *we have a dedicated risk project management team but we don't use them well enough, and as much as anything it's a cost thing, and a intuitive, optimistic or biased thing that I as a project manager have my risk register then I will manage that and the metrics around it, the data around it.*

5.2.6 Managing OH&S

Project managers are obligated to design and deliver projects that are safe. In terms of OH&S, the analysis of interviews highlights that project managers should be knowledgeable of their obligations under OH&S, and ensure that the associated risk is sitting with the right party: *I think that is sometimes forgotten, you need to make sure as a project manager you are assigning risk to who should actually be controlling it and that is particularly true on safety as you don't want to be taking that on. (Project Manager A).*

However, Project Manager B shared that people who are trained in occupational health and safety and their view of the world is sometimes difficult to manage as a project manager. So you've got to make decisions around level of risk that you accept for yourself or for your client... *..Safety analysis and their safe work methods and all those*

things and inspections and they're all static things but you'll have a guy out there who is doing some work, and he's got his back to an excavator, and he may or may not get injured but that behaviour is at risk. In this situation, he shared the behavioural protocol that is followed in the Victorian projects' context, whereby leaders visit the site with their site project managers, project project managers and project directors:

We'll go out and we'll do an observation piece and we just watch the workplace happen. And we'll tick off the type of activity we're watching and whether the behaviour of the person or the team was a risky behaviour or not. And then we'll take that and have a conversation with them and one we did there was a guy working with an excavator moving a big chunk of asphalt that had just been dug out of the road. The guy had his hands down near the asphalt and the excavator was moving those things and we must said why did you continue to work when you knew the excavator was doing stuff and his answer was well I trust the guy in the excavator cause I've worked with him for four years and I could see and I had gloves on. So it's about having the conversation around [such risky] behaviours.

In closing, we ask our interviewees about the competencies and skills required of an effective project manager in this infrastructure space and the behaviours that are associated with those skills. In Project Manager A's view: *one of the most important skills is being able to step away from the technology and still engage on a human level with project partners.* Whereas in Manager B's view *the answer is there isn't one. It's everything, and I think that's the thing. I think it's one of taking responsibility for the delivery of the project and its outcomes and everything underneath that.* He added: *I guess this is the behaviours, to get organised, to plan, manage and control.... There's a whole bunch of underlying skills and techniques and tools to do that. So the skill is to know which one to use at which time which means the skill is really understanding what is important in your project.*

6. DISCUSSION

Major infrastructure projects are the delivery vehicle for the development, expansion and extension of Governmental investment that is intent in place making. Whilst a successful

engine for change, major projects have been under scrutiny for their poor success record, attributed to challenges associated with technological disruption, changing requirements and scope of the project, mis-management of project's risk and stakeholders' concerns in addition to a host of sustainability-related issues. This paper explores multi-level competencies for project success in the context of major infrastructure development projects in Australia through an exploratory qualitative inquiry based on experienced project managers' views of key challenges encountered and the requisite competencies and skills to offset the same.

The participating project managers shared their varied views on project success: 1) project success is about managing the stakeholders' expectations, 2) establishing clear communication with the client on appropriate level of contingency planning for change, and 3) the client or project owner gets what they needed out of the project. This highlights the complexities in defining the notion of project success (Joslin & Müller, 2015; Koops, Bosch-Rekeldt, Coman, Hertogh, & Bakker, 2016; Radujković & Sjekavica, 2017). To quote Manager B: *Successful projects rely on a good project manager who can define the requirements and make sure those technologies meet that and then take the project on the journey to deliver on it*

Indeed, major projects are complex entities involving a complex array of activities which shape the notion of success. In meeting the criteria of project success in major infrastructure projects, project managers confront numerous challenges. They are challenged by their schedule constraints, budget, their community's concern to protect the environment and conserve resources, their workers' concern to ensure safe jobs and injury free work sites, and their limited information processing capabilities in the age of big data and BIM tools (Ahmad et al., 2019; Alaghbari, Razali A. Kadir, Salim, & Ernawati, 2007; Long, Ogunlana, Quang, & Lam, 2004; Mok, Shen, & Yang, 2015).

The rapid adoption of ICT and other sophisticated technological tools and applications poses a major challenge for project managers to be competent in digital skills. Given the long duration of major projects, technological advancements imply that the technology in-use could get outdated soon. This requires project managers to exhibit quick on-the-job learning and adaptability (Heunis, 2016). Thus, a key to sustainable project development may lie in

reshaping their technological competencies and skills: *I see that as future generations are coming through our reliance on technology for communication tools is so heavy you know already you see younger project managers you talk to them you say, have you spoken to the clients about that and they say yep yep yep and you go what did you actually do and they go are we sent an email or we sent a text message so I think the challenge and the skills they need to have is being able to step away from your phone or your computer and have a conversation with somebody and I think that is going to get lost and it's going to have to be a conscious thing that we are making sure the project managers are still doing because it is a human based thing whatever you are doing* (Project Manager A).

This highlights that project managers need to develop skills in communication and empathy.

Similarly, in the construction industry context of Australia, the preservation of the natural environment during project execution is a key. Construction activities should be performed in a manner that minimizes their environmental impact and safety risks. Accordingly, project success requires proper consideration of environmental issues by considering the ethical implications of the resources used. This may require training on ethics.



Figure 1. Proposed Framework of Competencies and Skills

The findings also highlight the importance of strong leadership skills, particularly to manage the critical aspects of health and safety in the project environment. For example, the experience of Manager B clearly showed that OH&S management is not about having policies in place and ticking against them, but rather active vigilance of the environment and deep conversations around potential risky behaviours to determine the level of expertise and level trust among workers undertaking risky tasks. This shows the importance of leadership qualities of project managers and their ability to bring the best out in their team.

7. CONCLUSION

The increasing complexity of managing large construction and infrastructure development projects in Australia presents a variety of emerging challenges for project managers/leaders. It is therefore not surprising that project managers require a new level of competencies and skill sets to remain competent for successful project delivery. To identify these new competencies and skills an extensive review of major projects from the project management literature was conducted. From the extant literature, 14 challenges were identified. These challenges ranged from the standard challenges that have plagued project managers for years:

schedule delays caused by a variety of issues; poor coordination from poor communication, cost overruns, contractual problems, poor stakeholder management and conflict management for example. However, several new challenges emerged, such as the emergence of ICT where new technologies had difficulty fitting into current practices, the use and ability to process big data, sustainability, and corporate social responsibility. To understand how project managers respond and react to these key challenges, exploratory research was conducted using a qualitative data approach. From the literature, a set of key themes provided the base to develop a template for a set of interview questions. Interviews were conducted with project managers to obtain a deeper insight into the nature of the new challenges.

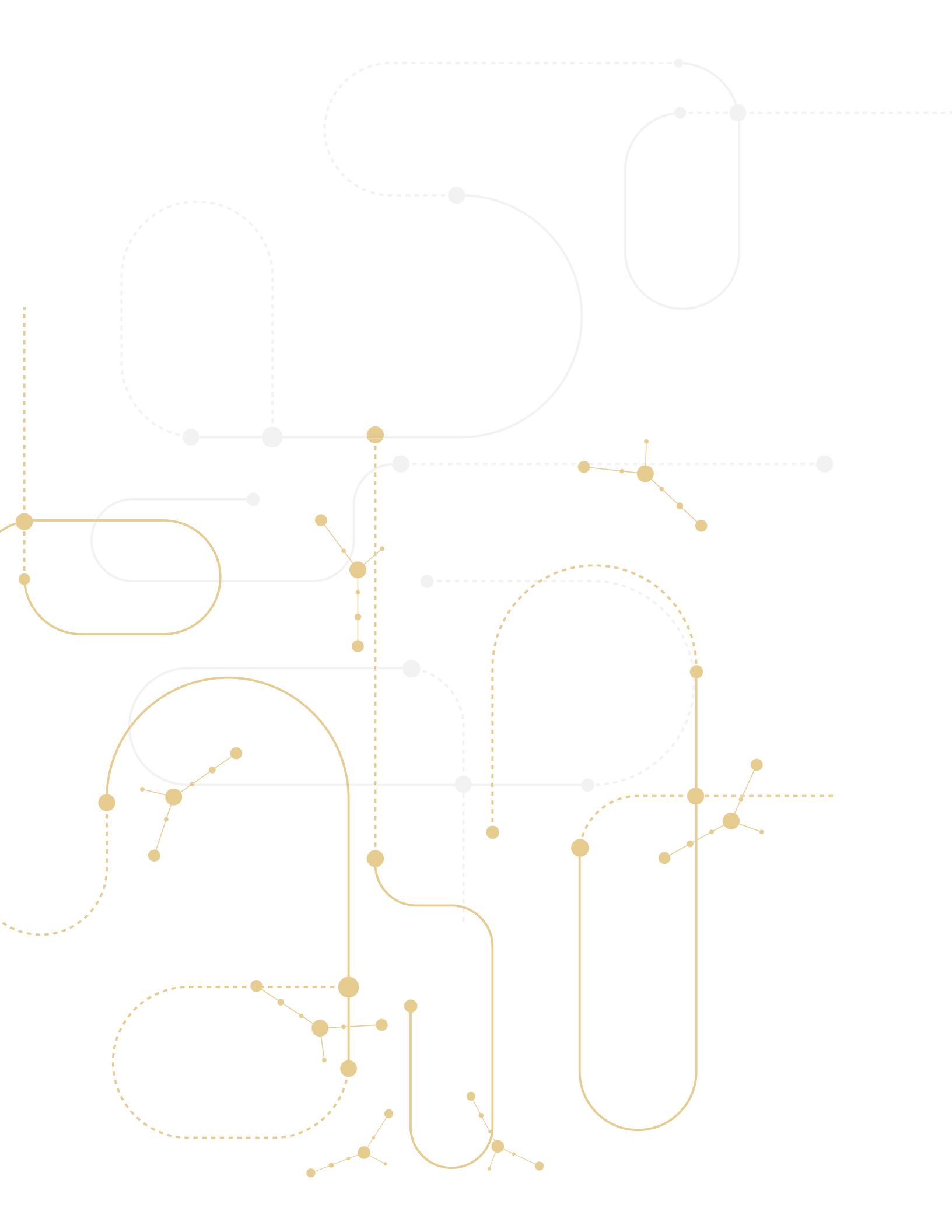
From the interviews two major themes were identified: key challenges and key competencies faced by project managers of major infrastructure projects. It can be seen from these challenges and competencies that managing major infrastructure projects involve major complexity. Project managers are challenged by schedule delays, scope changes, cost concerns, managing stakeholders' expectations, coordination problems, procurement issues and technology. It is argued that these challenges and competencies have a role in determining project success.

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Operational Excellence versus Breakthrough Innovation

ABSTRACT

The article aims to explain the role of trust for team performance. We show that teams consisting of similar team members are more likely to achieve cohesiveness and trustful relationships. They are also more likely to achieve alignment about strategic and operational goals and values. In comparison to cohesive teams, the article presents the advantages of highly heterogeneous teams that are more likely to be successful when there is a need to develop new innovative solutions. Diverse teams should invest in building trust in order to be able to achieve results. The article shows how trust is established and maintained during the phases of team development processes. Teams should establish trust during the team formation stage and maintain it throughout project duration. We have recognized that organizational culture and the levels of controlling as important determinants of establishing trustful relationship. The article also presents the role of leadership in establishing and maintaining trustful relationships. Moreover, we show that the key to success is to have the right degree of cohesiveness and right degree of innovativeness that should be determined based on the type of the project, project complexity and the purpose of the project. The article is based on literature review, which provided a foundation for a model building and a comparison of highly cohesive teams versus diverse teams.

Keywords: Trust; Cohesion; Project Performance; Heterogeneity; Efficiency; Effectiveness

1. INTRODUCTION

Projects teams, especially those with multiple stakeholders find establishing trust increasingly challenging and impor-

tant for reaching project goals and sustainable operation. Trustful relationships can only be established based on appreciation and respect among team members. Nowadays work relationships are often based on short term contracts. Companies and individuals who manage to establish themselves as entrusted long-term partners that ensure quality products and services, are more likely to gain another contract or get their existing contract extended. Trust holds teams and companies together and once it is gone every system will likely disintegrate. Trustworthy relationships and ability to resolve conflicts with efficient communication with multiple subcontractors is one of the most important factors of successful completion of projects. The inability of a project team to establish trustful relationships is likely to damage not only the project but the sustainable operations of a company on the long term. Teams, individuals, companies and brands are striving to be perceived as trustful, since this helps them rise and prosper. Trust has great economic consequences since it influences business decisions. It shapes the decisions such as where and with whom somebody forms business partnerships and makes investments.

The purpose of the article is to increase the awareness about the role of trust in business operations. The goal of the article is to present characteristics of teams which are more likely to establish trust and to present the role of trust in connection with the specific project team goals. The article intends to answer the question in which situations and under which conditions teams with predominately similar team members are more likely to achieve success in comparison with teams with highly diverse team members. We compare two opposite project outcomes that teams pursue, operational excellence and breakthrough innovation. The article therefore explains the role of trust for team performance and the factors which contribute to trust. Understanding

how trust is built and maintained in business relationships is important at the level of individual, the team and the entire company. Trustful relationships enable efficient communication and loyalty and are based on reliability, fairness, honesty and authenticity. The awareness about the importance of trust and the understanding of how it can be developed helps managers as well as individual team members to select the right team and the right goals and to develop trustful work-related relationships.

The article provides a model that compares highly cohesive teams that are better at providing operational excellency versus diverse teams that excel in providing new innovative solutions. The model is build based on the literature review. We emphasize that diverse teams find it more challenging to build trust which is essential for efficient communication and long term success.

First, we present how trustful relationships are established and maintained. Establishing and maintaining trust occurs during the phases of team development processes that are described in the article. Next, we explain how trust is achieved and present in detail two of the most important aspects of establishing trustful relationship, the organizational culture and the levels of controlling.

Next, we explain that trust within the team effectiveness frameworks can be considered as an enabler, mediator and/or consequence of team activities. Team effectiveness frameworks include an overview of project success factors including enablers, mediators and results. In this context, the efficiency of the project relates to reaching the three operational goals, including budget, deadline and quality goal. Whereby, the effectiveness relates to achieving overall success, which includes not only the satisfaction of team members, project sponsor, customer, local environment and other stakeholders but also the prioritisation and the selection of projects.

Finally, we compare teams that pursue operational excellency and teams that pursue breakthrough innovation. We show that highly efficient operational teams are highly cohesive and homogenous and that highly innovative teams which are more diverse need to put more effort to build and maintain trust. Team cohesion (Forsyth, 2010) is one of the most important concepts of group dynamics that considerably contributes to project success and vice versa. Hetero-

ogeneity or diversity reflects the differences between team members and the homogeneity reflects the similarities. Teams over time usually develop shared mental model that is (Mohammed and Dumville, 2001) an “organized understanding of relevant knowledge” that team members share, to be able to improve communication, “information sharing, transactive memory, group learning and cognitive consensus”. Transactive memory system as defined by Wegner (1987) is a “set of individual memory systems in combination with the communication”.

2. ESTABLISHING AND MAINTAINING TRUST IN TEAMS

Establishing trust is one of the most important aspects of transformational (Bass et al., 2003, Bass and Avolio, 1993) and ethical leaders (Mihelič et al., 2010). To initiate trust the teams should align around the goals of the project and develop their specific shared mental model. The establishment of trustful relationship goes hand in hand with the team development process.

1.1 Establishing trust and team development process

Ilgen et al. (2005) describe that team development goes through three main phases, the forming, the functioning and the finishing phase. Trust becomes especially crucial during the phase of team formation, when the trust in the team's ability and in the team members' intentions (Ilgen et al., 2005) should be established to ensure prosperous and safe environment for team members to work and develop. During the forming phase, emphasis is put on trusting (including potency and safety), planning (which includes gathering information and developing strategy) and structuring (which includes establishing shared mental models and transactive memory). During the functioning phase, emphasis is put on bonding between team members (which includes management of diversity and conflict management), on adaptation (which includes performance in routine versus novel conditions, helping and workload sharing), and on learning from the minority, from dissenting team members and from the team's best member (Ilgen et al., 2005).

The team processes that evolve over time include cognitive, motivational, affective and behavioural team process-

es (Kozlowski and Ilgen, 2006). According to Kozlowski and Ilgen (2006) the cognitive team processes are based upon the climate of the unit and of the team, upon team mental models, transactive memory and team learning. The interpersonal, motivational and affective processes and emergent states are closely related to team cohesion; team efficacy and group potency; affect, mood and emotion; and team conflict. While the team action and behavioural processes are based upon coordination, cooperation and communication; team skill competences and performance functions and regulation; performance dynamics and adaptation (Kozlowski and Ilgen, 2006).

1.2 Building and maintaining trust

Trustful relationships can be built and maintained based on appropriate behaviours. Covey and Merrill (2006) describe these behaviours within five waves of trust: self-trust, relationship trust, organizational trust, market trust and societal trust.

Companies gain societal trust based on socially responsible practices that are based on contribution to society. Market trust is achieved when the company has renowned brand and good reputation or when an individual has rich references and good reputation. Organizational trust is built

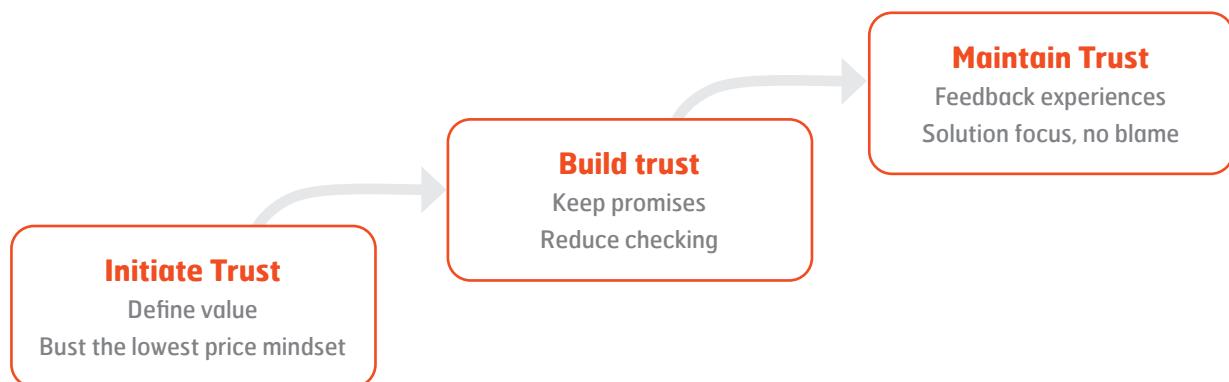


Figure 1. Trust (Source: Gill Thomas and Mike Thomas, 2005: Construction partnering & Integrated Teamworking)

Thomas and Thomas (2005) suggest as shown in the figure below that building trust is based on a team culture that supports fulfilment of given promises and introduces the right amount of controlling. They suggest that in practice the levels of controlling are too high and should be lowered in order to establish trustful atmosphere. Additionally, Thomas and Thomas (2005) propose that trustful relationships can only be sustainable on the long run if the team members are able to provide work related feedback with an aim to improve the results of a task or of a project without any personal connotations. Team discussions should be focused on finding the solution to a problem and not on finding and blaming the culprit who contributed most to the problem.

Based on that, it is evident that organizational culture and the right levels of controlling are among the most important aspects of establishing trustful relationship.

on sharing information openly, tolerance and encouraging mistakes, innovation and creativity and sharing credit with a team (Covey and Merrill, 2006). The individuals, teams and organizations have the most power to influence the self-trust and the relationship trust on which other waves of trust are founded on.

Self-trust is based on credibility which is achieved through integrity, intent, capabilities and results (Covey and Merrill, 2006). Integrity can be developed by making and keeping commitments to yourself, standing for something and openness. Intent can be developed by examining and redefining the motives, declaring intent, choosing abundance. Capabilities can be developed by running with the strengths, keeping oneself relevant, knowing the direction and goals. Finally results can be reached by taking responsibility, expectation to win and finish strong (Covey and Merrill, 2006).

Covey and Merrill (2006) have found that the following behaviours support relationship trust: talk straight, demonstrate respect, create transparency, make restitution of wrongdoings, show loyalty (character based behaviours), deliver results, get better, confront reality, clarify expectations, practice accountability (competence based behaviours), listen first, keep commitments, extend trust (character and competence based behaviours).

Covey and Merrill (2006) explain that trust is difficult but not impossible to restore. In their view, each situation can be seen either as the zone of a blind trust which is based on gullibility, the zone of smart trust which is based on judgement (high propensity and high analysis), the zone of no trust which is based on indecision and the distrust which is based on suspicion.

1.3 Organizational culture

The mainstream literature views organizational culture "as a pattern of shared organizational values, basic underlying assumptions and informal norms that guide the way work is accomplished in an organization" (Harris and Beyerlein, 2003). Since projects are mostly still based on some degree of hierarchical structure and the powers of project stakeholders are often not as equal as agile project management practice aspires, the leader's influence on establishing trustful relationships remains indisputable. Namely, an "organizational culture develops in large part from its leadership while the culture of an organisation can also affect the development of its leadership." (Bass and Avolio, 1993). Complex projects commonly include members from different organizations and/or different national cultural backgrounds, which makes the collaboration and establishment of trustful relationships even more challenging. Long term teams

within an organization often establish their own specific culture including specific communication, work habits and ways on how work is performed, which quite often differs from the culture of the organization within which they operate. While considering the fact the culture of an organization and of teams constantly interact (Hofstede, Hofstede, and Minkov, 1997, Seymen, 2006), the culture of a cohesive team with trustful work-related relationships should be based on searching for solution to a problem.

1.4 Trust and controlling

As mentioned previously, the right degree of controlling is an essential part of building and maintaining trust. LaFasto and Larson (2002) found out how different levels of controlling impact satisfaction with work relationships, therefore including trust among team members.

As it is presented in the figure below abandonment of control is a sign of abdication, insufficient care and low desire to disclose personal views. On the other hand, high levels of control are the sign of over management, undervaluation of the other person's ideas and lack of concern about other people's feelings. Excessive control is typical for micromanagement, a managerial style with many negative connotations and inability to focus on major details. It leads to lack

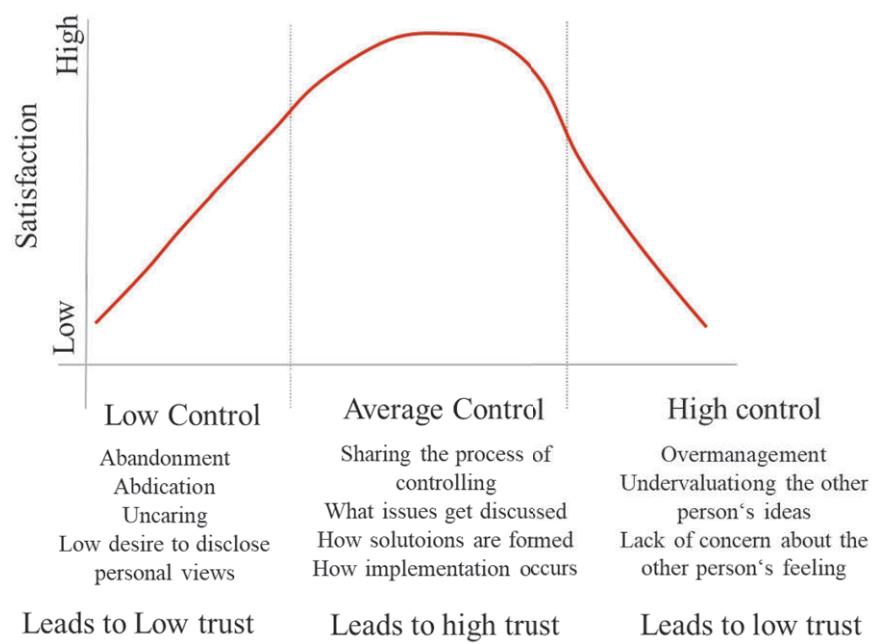


Figure 2: Control and relationship satisfaction (Source: LaFasto, Larson, 2002, p. 118)

of freedom and it includes too much emphasis on managing minor details.

Both, the insufficient control as well as excessive control are not only detrimental to the ability of establishing trust but can lead to management failure. It is therefore crucial to introduce the right levels of control that are based upon shared process of controlling as well as on discussing relevant issues, searching for right approaches for finding a solution and plan implementation. Only when levels of control are appropriate there is a possibility that team establishes trustful relationships with which team members are satisfied.

3. TEAM EFFECTIVENESS FRAMEWORKS

Team effectiveness frameworks by different authors might consider trust as an enabler, mediator and/or consequence of team activities. Mathieu et al. (2008) sees trust as one of the emergent states of a team which are defined by Marks et al. (2001) as "cognitive, motivational and affective states" which "vary as a function of team context, inputs, processes and outcomes." Therefore, trust is a variable in the team effectiveness framework with reciprocal interdependence to other variables. On the one hand, it influences effectiveness by triggering positive or negative spirals and is at the same time influenced by team effectiveness (Sundstrom et al., 1990). Cohen and Bailey (1997) place trust as a dimension of member's attitudes that they consider it as a project success indicator, besides performance effectiveness and behavioural outcomes.

Trust plays a crucial role in ability to resolve conflicts and to communicate efficiently, which ultimately enables project success. In this sense it is an enabler and mediator of team success. Furthermore, trust enables not only better collaboration but also learning and exchange of knowledge.

Establishing trustful relationships, on the other hand is the result of process of team development, which includes the phase of team formation, functioning and finishing (Ilgen et al., 2005).

4. OPERATIONAL EXCELLENCE VERSUS BREAKTHROUGH INNOVATIVENESS

Trust is essential element of every team, regardless of its purpose or complexity. However, the levels of trust required to reach the desired goals might depend on the type of the goal that team aims to achieve, the type and the complexity of the project. Based on the literature review and findings from previous studies (Fink, 2017, Bole et al., 2016) we found that deadline and budget goals can only be reached in highly cohesive teams which are based on high degree of trust. On the other hand, we show that the quality goal and the innovativeness is increased in teams whose team members have broad range of different capabilities. The figure below shows two opposite approaches to building teams. First is based on the similarities among team member and the second on their differences. In case that team's priority is achievement of operational excellency the team should focus on developing shared mental models and shared transactive memory as well as on alignment around the values, project goals and project leadership. In project teams where the achievement of operational goals is the key, dif-

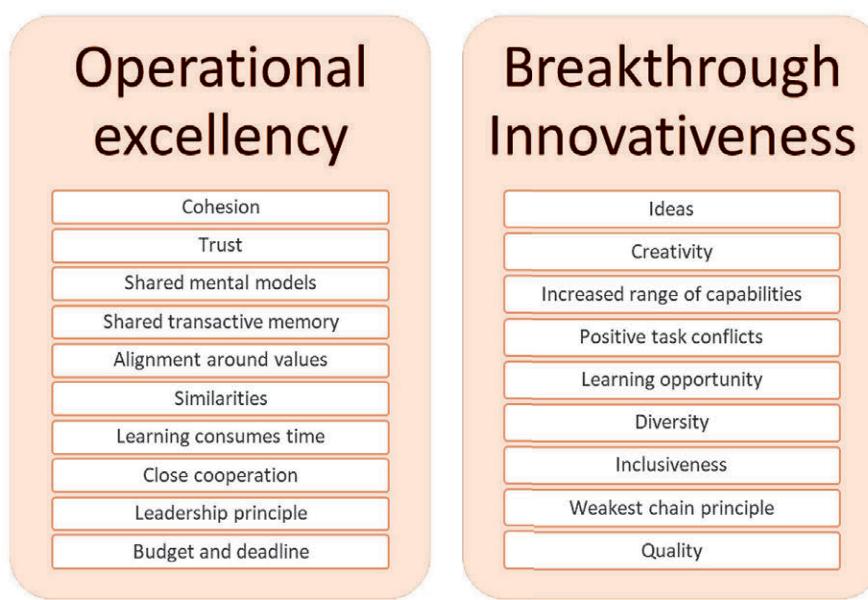


Figure 3: Cohesive and innovative teams (Source: Own)

ferences might be detrimental to project success. On the contrary, the literature shows that differences among team members contribute to the increased range of capabilities, which in turn increases creativity and ideas. Moreover, diversity matters whenever teams aspire to reach the quality goal (Fink, 2017, Bole et al., 2016). Diverse teams are more creative and possess the ability to develop breakthrough innovations.

Every team, let it be homogenous or heterogenous, should establish some degree of work-related trust in order to operate. Building and maintaining trust is namely essential for achieving long term success. However, highly diverse groups find it more challenging to build trust. Trust is namely closely associated with cohesion among team members which in turn is closely associated with the similarities among them. The operational excellency that is based on high cohesion and breakthrough innovativeness that is based on broad range of different capabilities are described in more detail below.

1.5 Operational excellency is based on high cohesion

Cohesion and trust go hand in hand (Horwitz and Horwitz, 2007). Namely, there is no trust without cohesion and no cohesion without trust. Furthermore, cohesion and trust are associated with close cooperation of team members, development of shared team mental models and transactive memory (Kozlowski and Ilgen, 2006), team alignment and goal commitment (Latham, 2009) and alignment around values (Kirkpatrick, 2009). The faction of researchers including Forsyth (2010) claim that cohesion and trust are most important determinants of project success. In general, lower levels of heterogeneities among team members contribute to team cohesion. Cohesive teams aligned around the team's and company's vision, strategy and shared goals are more likely to be aligned around operational organization of tasks and team leadership. This is supported by the finding by Harrison et al. (1998, 2002) showing that differences in values among team members are detrimental to project success. To emphasise the alignment around the strategic issues, Kellermanns et al. (2005) define strategic consensus as "the shared understanding of strategic priorities among managers at the top, middle and/or operating levels of the organisation." Team cohesion and trustful relationships support the exchange of information. The efficient

exchange of information and efficient collaboration among team members based on trustful relationships according to Walker et al. (2017) contributes to lower uncertainty and lower likelihood of risk occurrence.

Highly cohesive teams should develop shared mental models that are defined by Mohammed and Dumville (2001) as "organised understanding of relevant knowledge that is shared by team members" that is related to "information sharing, transactive memory, group learning and cognitive consensus". Wegner (1987) defined transactive memory system as a "set of individual memory systems in combination with the communication". This includes the awareness about the amount of knowledge stock, about who knows what and knowledge specialisation (Austin, 2003, Ilgen et al., 2005, Moreland, 2013). Based on Cannon-Bowers, Salas, and Converse, (1993) and Mathieu et al. (2008) teams simultaneously possess multiple mental models that are gathered either around technology, task, team interaction or team. Several authors, among others, Kozlowski and Ilgen (2006), Mathieu et al. (2005, 2008), Marks et al. (2000), Converse, Cannon-Bowers, and Salas (1991) provide evidence that shared mental models and transactive memory systems contribute to better team performance and influence other team processes.

Furthermore, Kozlowski and Ilgen (2006) recognise that the development of transactive memory systems is supported by familiarity, shared experience and face to-face interaction, among others. Similarly, the development of shared mental models is supported by leadership, training (Marks et al., 2000, 2002) especially different types of joint team trainings (Salas et al., 2008) and common experience. Shared mental models on the level of an organization, similarly to organizational culture interact with the shared mental models of a team.

1.6 Breakthrough innovativeness

Diversity offers an opportunity for teams that require wider range of capabilities, talents and traits. Often innovative teams such as research and development teams, require access to wider pool of capabilities that contribute to long term effectiveness. Moreover, diversity among team members that is always present to some degree offers the opportunity for learning. However, research shows that diversity harms cooperation and cohesion and causes conflict (Joshi

and Jackson, 2003, Forsyth, 2010, Williams and O'Reilly, 1998, Horwitz, and Horwitz, 2007, Stewart, 2006, Van Knippenberg and Schippers, 2007, Van Knippenberg, De Dreu, and Homan, 2004).

Although some researchers and practitioners believe that conflict is essential for achieving better results, De Wit (2015) explains that especially relationship conflict which stems from the mismatch in norms, values, personalities, as well as process conflict, which stems from the disagreement about the "logistics and distribution of assignments" (De Wit, 2015) are detrimental to project efficiency in different project settings. On the contrary, task conflict which stems from the disagreements about "the content and outcomes of the task" can have a positive outcome. However, the nature of the conflict is such that it is inclined to escalate. Whenever task conflict triggers relationship conflict it becomes detrimental and damaging for performance. In such a sequence of events task conflict which has escalated into relationship conflict becomes especially damaging in teams of complex projects and task (De Wit, 2015). According to De Wit (2015) the decision-making teams are more likely to benefit from task conflict since they perform better at "preventing task conflict from co-occurring with relationship conflict" than other types of teams.

Researcher differentiate between different types of heterogeneities. Mathieu et al. (2008) for instance differentiates between differences in demographic status, functional status, personality attitudes and values, as well as in faultiness, position and status issues, network features. Further, according to Harrison et al. (2002) some differences are easily observed and measured (surface-level diversity) while others such as values attitudes, preferences, beliefs are harder to observe. Moreover, Harrison and Klein (2007) distinguish between diversity as a separation (e.g. differences in position or opinion), as a variety (e.g. differences in information, knowledge, experience or other category) and as a disparity (e.g. differences in concentration of resources, differences in pay, status or other socially valued assets). In addition, Fink (2017) and Bole et al. (2016) investigate heterogeneity in the number of complementary competencies and heterogeneity in the level of competencies' assessments. At determining the degree of diversity, it is important to consider that several different competencies, can describe same or similar construct and are overlapping, while only some are complementary. They show that competence heterogeneity is beneficial

for achieving the quality goals, whereas the budget and the deadline goals are more likely to be achieved in teams with strong leadership and similarity in competencies.

5. CONCLUSION

Work related trust enables constructive cooperation among team members. The article shows that teams consisting of team members that are highly similar are more likely to achieve cohesiveness and build their relationship on trust. They are also more likely to achieve alignment about strategic and operational goals and values. In comparison to cohesive teams, the article presents the advantages of highly heterogeneous teams that are more likely to be successful when there is a need to develop new innovative solutions. Trust is essential for every team. However, heterogeneous teams find it more challenging to build trustful relationships.

The article explains that trust is established and maintained during the phases of team development processes. Team should establish trust during the team formation stage and maintain it throughout project duration. We have recognized that organizational culture and the levels of controlling as important determinants of establishing trustful relationship. Organizational culture as well as levels of controlling are predominantly determined by leadership. The role of leadership in establishing and maintaining trustful relationships is indisputable. Managers are more likely to introduce reasonable controlling and monitoring of project activities when work relationships are based on trust. On the other hand, the absence of work-related trust might lead to micromanagement and extreme supervision with deteriorating effects.

The article provides comparison of teams that aim to reach the operational excellence versus teams whose priority is to create a breakthrough innovation. By comparing these two different endeavours, we found out close connection between operational excellence and team cohesiveness on the one hand and between pursue for breakthrough innovation and team diversity on the other hand. Although diverse teams find establishing trust especially challenging, they should strive to establish trustful relationships in order to achieve their goals. Diverse teams should therefore introduce methods by which they can foster trust which is required to be able to benefit from the diverse knowledge, ex-

pertise and other competences which team member will be willing to share only in trustful environment.

Work related trust in teams that are focused on operational excellency, is established when all parties can rely on the other party that work tasks are going to be fulfilled within the agreed quality, deadline and budget, while good personal relationships and stakeholder satisfaction are maintained.

We show that trustful relationships encourage efficient exchange of information and collaboration among team members and contribute to lower uncertainty and lower the likelihood of risk occurrence. To sum up, the key to success is to have the right degree of cohesiveness and right degree of innovativeness that should be determined based on the type of the project, project complexity and the purpose of the project.

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A Trust Model for Analyzing Team's Relationship in Product Development Project

ABSTRACT

In product development (PD) projects, coordinating the complex patterns of interdependencies, relational trust or reciprocity among teams is a fundamental challenge. Many models of product development are concerned with managing the decomposition and integration of teams. However, core teams need to be identified to better understand and control the organizational network. We propose a model to find the role of trust in tie strength in product development projects. Feelings of trust between teams are influenced by communication frequency, competence, benevolence and integrity. To increase tie strength among teams especially in PD projects in which technical tasks are decisively knowledge-intensive, project managers need to attend to these variables. Then Social Network Analysis (SNA) is used to find core teams. The conclusions confirm that trust affects teams' positions within a social network and changes the structure of the organizational network by influencing the reputation and status of teams.

Keywords: Product Development Organization; Trust; Tie Strength; Core Teams

1. INTRODUCTION

Nowadays, the development of complex products is a challenging task that requires the coordination of dozens or even hundreds of teams (Yang et al., 2018). Interaction tie is the most important factors in PD (Batallas & Yassine, 2006). Academics have found interaction tie to be significant for acquiring information (Burt, 2009), learning how to work, and solving complicated problems. Thus, capturing the in-

teraction tie with PD organization is critical for conceiving effective communication and coordination strategies resulting in an improved PD process.

Granovetter (1977, p. 1361) originally defined tie strength as a "combination of the amount of time, the emotional intensiveness, mutual trust which characterize the tie." Therefore, trust is a key factor in social relationships, and is one of the most basis factors of the formation of tie strength and team performance within a PD organization. Zhang et al. (2017) proposed that social interaction ties mediate the effect of network. Aside from team interdependencies, mutual confiding still play significant roles as network resources not only in accelerating repeat cooperation(Sorensen and Waguespack, 2006), but in supporting longer-term relationships(Manning and Sydow, 2011). Shazi et al. (2015) examine the impact of trust on the establishment of social network ties for the idea generation and idea realization stages of innovation. Earlier researches propose that there might be complicated communications between many dimensions of trust in organizational network. Casciaro and Lobo (2005, 2008) present that interactive affect (e.g. trusting another) will moderate the effect of ability on the establishment of task-related ties. Other researchers (Du and Mao, 2018) argue that PD organization teams require not only the initial trust but further development and maintenance of that trust. To extend this finding to trust in PD organizational networks, we propose a social network model to find the trust relationship in organizational network.

Trust in PD organization is a multi-dimensional construct which represents consent of a trustor to have confidence in a trustee for his optimistic behavior. A trustor represents a team who evaluates how much he credits a trustee where-

as a team who is being evaluated by trustor is referred to as trustee (Baek and Kim, 2014). Some teams are part of the organizational network, but not all teams are equally important. Core teams depend on “network mechanisms”, such as reciprocity, trust, and inter-dependence. They are crucial sources of learning and competence development, particularly since the development of project competences requires resources and knowledge beyond the boundaries of some specific teams (Schuessler et al., 2012). When the project requires the adding of new knowledge, core teams are significant mechanisms where new expertise becomes absorbed and combined with established knowledge (Manning and Sydow, 2011). However, (Cobo-Reyes et al. (2017) propose that trust shouldn't be ignored in PD teams.

Consequently, this paper proposes the modeling and analysis of the trust tie strength within PD organizations and identifies the “core teams” in complex PD environments. We explain how to identify core teams in PD organizational network based on SNA techniques.

2. LITERATURE REVIEW

To model trust, the fundamental idea of trust, trust types and trust properties in PD organizational network trust model should be discussed.

Mayer et al. (1995) state trust as “the will of a party to be susceptible.” (Mayer et al., 1995) provides significant evidence that trusting relations result in greater knowledge sharing: While trust exists, teams are keen to share worthwhile knowledge (Andrews and Delahay, 2000) and also more willing to absorb others’ expertise. Grossmana and Feitosa (2018) propose a theoretical model of team trust in action teams that incorporates its dynamic environment. Park and Lee (2014) point that teams share their knowledge when they trust their partners and feel dependent. These effects have been found at organizational levels of analysis in a variety of situations.

Trust can be divided into different qualitative types. McAllister (1995) differentiate between affect-based trust and cognition-based trust. Affect-based trust is based on emotional bonds between teams. Cognition-based trust is related to dependability, reliability, responsibility and competence. Mayer et al. (1995) define the trustworthiness consists of

three dimensions: Ability, Benevolence, and Integrity. (Becerra-Fernandez and Sabherwal (2001) propose that interaction frequency contribute to the improvement of trust. Chang et al. (2013) build various effective trust mechanisms and examine their interactions. On the basis of these discussions, certain features have repeatedly been found to be significant when building quality interaction tie. In this paper, we present a trust quantitative model for analysis of tie strength in the context of product development organization. “Strong ties” are described by previous cooperative experience and established trust (Schwab and Miner, 2008).

3. ANALYSIS METHODOLOGIES

3.1 Modeling Tie Strength based on Trust and Dependency

A large amount researches have been devoted to understanding how and why trust develops. We now concentrate on the characteristics of the tie strength between the trustor (a trusting team) and the trustee (a team to be trusted). How to foster trust in PD projects? That is to manage the process of interaction so that it leads to trust. In this paper, we find four dimensions of trustworthiness, technical communication frequency, competence, benevolence and integrity, as shown in Figure 1. The correlation between integrity and trust contains the trustor’s perception that the trustee keeps to a series of principles that the trustor finds acceptable.

3.1.1 Technical interaction frequency between overlapped activities

Frequent technical interaction in which conflicts are solved with teams builds positive trust, and frequent technical interaction will also influence PD teams’ relations with their partners (Massey and Kyriazis, 2007). More frequent interaction facilitates an understanding of team characteristics and the PD organizational context, which will contribute to the improvement of trust. In sum, frequent technical interaction frequency can improve the trust, reduce coordination costs, and improve team performance. In this paper, we focus on the technical interaction frequency in the overlapping processes which is a typical characteristic of PD projects, and they have a significant impact on trust coordination and communication between organizational teams.

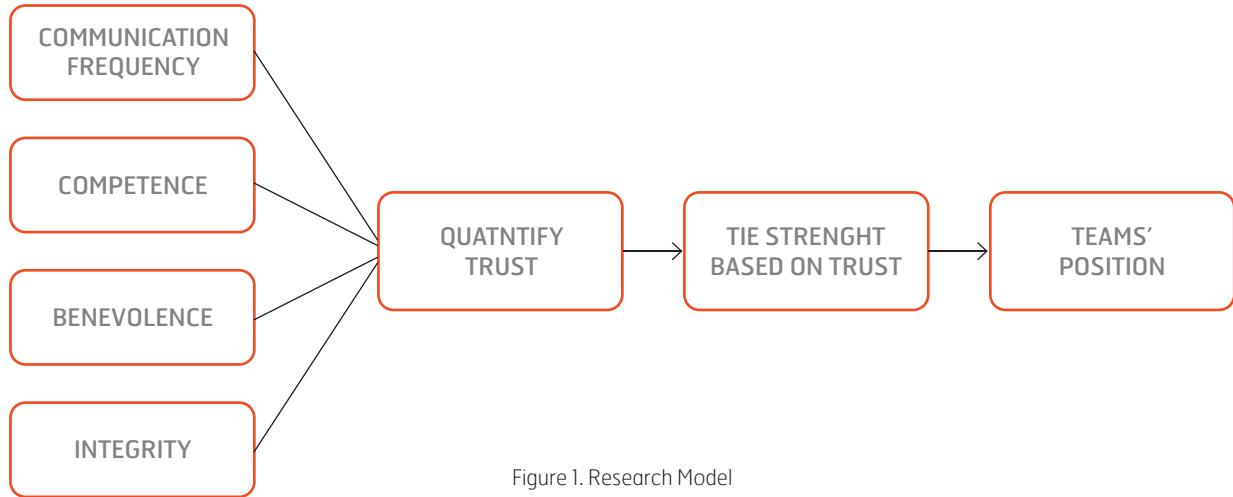


Figure 1. Research Model

Yang et al. (2014) proposed the theory of *evolution DSM* ($E(i,j)$) and *sensitivity DSM* ($S(i,j)$) to describe forced overlapped process. The more overlapping time is, the more technical interaction is required between teams. The technical interaction frequency between teams performing the overlapped activities i and j can be calculated with Equation (1) (Yang et al., 2014).

$$TIF(i, j) = 1 + \varepsilon(2E(i, j) - 1) \quad 1$$

where ε is a shape parameter for $TIF(i, j)$.

We then calculate the local relative interaction frequency in each row and column:

$$RTIF_r(i, j) = TIF(i, j) / \sum_{j=1}^N TIF(i, j) \quad i \neq j \quad 2$$

$$RTIF_c(i, j) = TIF(i, j) / \sum_{i=1}^N TIF(i, j) \quad i \neq j \quad 3$$

Finally, we calculate the global relative interaction frequency between activities i and j by taking average of

$RTIF_r(i, j)$ and $RTIF_c(i, j)$: and: $RTIF_r(i, j)$ and $RTIF_c(i, j)$:

$$AET(i, k) = z(i, k) / \sum_{k=1}^{N_k} z(i, k) \quad 4$$

3.1.2 Competence-based trust

Competence involves the cognitive beliefs about the other team's competencies and expertise that facilitate him to have impact in a specific expertise domain (Mayer et al., 1995). The area of the expertise is particular because the trustee can be competent in some technical area, giving that team trust on tasks related to that domain.

To measure competence-based trust, 1) we use a function of how a team allocates his or her communication effort (i.e., the time of communication) across expertise areas to measure the area of the expertise of team. 2) then we use common expertise (CE) in various areas to measure the similar competence between teams.

Expertise includes two key components: *know-what* and *know-how*. We extend know-what and know-how as proposed by (Sosa, 2014) to the PD context. *Know-what* can be represented by the product-related expertise, e.g., the components or subsystems of a product. *Know-how* can be represented by process-related expertise, e.g., designing, manufacturing and testing in the lifecycle process of a PD project. The involvement degree of team i in the expertise area k can be measured as the ratio of team's spend time to team's entire effort involved all expertise areas. The area of the expertise of team can be calculated as follows:

$$AET(i, k) = z(i, k) / \sum_{k=1}^{N_k} z(i, k) \quad 5$$

where z is the time or effort that team i spends in the area k , N_k is the number of areas.

Then we present equation (6) to quantify the level of common expertise (CE) between teams in the expertise area k :

$$CE_k(i, j) = \begin{cases} \frac{\min\{AET(i, k), AET(j, k)\}}{\max\{AET(i, k), AET(j, k)\}} & \text{if } AET(i, k) + AET(j, k) \neq 0 \\ 1 & \text{else} \end{cases} \quad 6$$

where $AET(i, k) + AET(j, k) \neq 0$ means that at least one team is involved in the area k .

The total common expertise between team i and j is calculated by Equation (7).

$$CompeT(i, j) = e^{-\sqrt{\sum_{k=1}^{N_k} (1 - CE_k(i, j))^2}} \quad 7$$

We assume that the more common expertise is, the more competence-based trust is required. Common expertise is expected to have a positive effect on trust because it is easier for a team to accumulate knowledge in areas in which he or she has made prior investments.

3.1.3 Integrity-based trust

Integrity refers to the perception that the other party adheres to a series of principles that the trustor finds acceptable, such as delivering on promises (Mayer et al., 1995). Integrity degree can measure integrity-based trust. If the communication is full of weak sense of integrity and the proportion of the relative technical interaction frequency can't be the representative of team integrity. Moreover, if the communication represents suggestion given from one team to another then the proportion (of the relative technical interaction frequency) will be used for calculating integrity degree.

High values of positive connections to a team will be a representative of the integrity from other teams (Nepal et al., 2011). It can be also called as the "credible communications about the trustee from other parties". We use integrity degree to calculate the attitude of other teams towards that team. The integrity degree is calculated by Equation (8).

$$IntegT(i, j) = \begin{cases} 1 & \text{if } Stro.RTIF(i, j) > Weak.RTIF(i, j) \\ 0 & \text{otherwise} \end{cases} \quad 8$$

Where $Stro.RTIF(i, j)$ is measured as the proportion of the relative strong technical interaction frequency between teams i and j relative to the total interaction strength with all their adjacent teams u , as shown in Equation (9). $Stro.RTIF(i, j)$ is calculated in Equation (10) denotes the weak technical interaction frequency coming towards i from his neighbors and $1/n$ is general average technical interaction frequency of team.

$$Stro.RTIF(i, j) = \frac{RTIF(i, j)}{\sum_{u=1}^n (RTIF(i, u) + RTIF(u, i))} \quad 9$$

$$Weak.RTIF(i, j) = 1/n - Stro.RTIF(i, j) \quad 10$$

3.1.4 Benevolence-based trust

Benevolence takes the perception that the other team has frank care and concern for the trustor and would like to do the correct thing by them, including sides of emotional connection and positive coordination (Mayer et al., 1995).

Benevolence-based trust encourages knowledge sharing by increasing the revelation of knowledge to others and by conceding others access to one's own knowledge. It can be considered by examining his emotional connection from other teams interacting with him. Benevolence-based trust of team is calculated at network level. If

a team shares knowledge in a PD organizational network, his benevolence-based trust calculation can use the reactions received on his knowledge by other teams. For benevolence-based trust, a lot of positive and negative reactions on a team's knowledge sharing are considered. Benevolence-based trusts are categorized and are given weights as mentioned in Table 1.

As shown in the Equation (11), benevolence-based trust (BenevT) of a team's knowledge sharing is calculated as the weighted sum of all reactions (positive or negative) on that sharing divided by the total number of reactions on that sharing.

Table 1. Categories of team reactions against knowledge sharing

Benevolence-based trusts	Possible Reactions	Weighted reaction ()
Positive reaction	Share	1
	Comment	0.75
	Love	0.75
	Wow	0.50
	Like	0.25
	Haha	0.25
Negative reaction	Angry	-1
	Dislike	-0.5

$$BenevT(i, j) = \forall j \in Network \left(\frac{(reac(j_{share}) \square R(i, j))}{\sum_{\forall reac \in REAC} share} \right) \quad 11$$

where $reac(j_{share})$ represents the reaction of team j against the knowledge sharing of team i and $R(i, j)$ represents the weight assigned to be reaction in the reaction set $REAC$. The higher $BenevT(i, j)$ is, the better benevolence i has otherwise not. The greater value of benevolence trust indicates that trustee i want other person (trustor) to do the right thing by them.

Finally, the value of tie strength between team i and j can be calculated by Equation (12).

$$TS(i, j) = \alpha \square RTIF(i, j) + \beta \square CompeT(i, j) + \gamma \square IntegT(i, j) + \delta \square BenevT(i, j) \quad 12$$

where, $\alpha = \beta = \gamma = \delta = \frac{1}{4}$

3.2 Social Network Analysis-Improved K-shell

Kitsak et al (2010) find that K-shell decomposition analysis can identify the most efficient spreaders that are located within the core of the network, which is expressed with $Ks(i)$. A network is split into k-shell structure in this method, as shown in Fig.2. The classical K-shell decomposition method is suitable for analyzing unidirectional and unweights networks, but the tie strength between teams has complex directed weighted relationships and the tie strength between them is different. Garas et al (2012) introduced a k-shell decomposition method for weighted network, but it cannot be used in the directed network, the tie strength in the opposite direction of which is different. In addition, the weighted k-shell decomposition only presents the location of teams in the network and the tie strength between teams, the attributes of the teams was not considered. Hence, this paper introduces tie strength between teams and team attributes to improve the weighted k-shell method, layer the teams, and then identify the core teams.

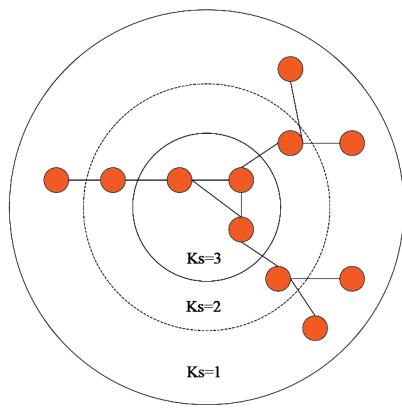


Figure 2. Classical K-shell decomposition process

The formation of the tie strength between teams is affected by the team attributes, so we take the tie strength and team attributes as the new degree, that is:

$$K'(i) = \left[K_I(i)^{\alpha_1} \times \left(\sum_{i=1}^n TS_{ij} \right)^{\beta_1} \right]^{\frac{1}{\alpha_1 + \beta_1}} + \left[K_o(i)^{\alpha_2} \times \left(\sum_{j=1}^n TS_{ji} \right)^{\beta_2} \right]^{\frac{1}{\alpha_2 + \beta_2}} \quad 13$$

where, $K'(i)$ is the improved k-shell of team i , $K_I(i)$ and $K_o(i)$ are the In-degree and Out-degree of team i , TS_{ij} is tie strength between team i and j .

In this paper, we discuss only the case when $\alpha_1 = \beta_1 = 1$, $\alpha_2 = \beta_2 = 1$, which treats the weight and the degree equally. The full exploration of the parameter space is beyond our scope and is left for future work. Therefore,

$$K'(i) = \sqrt{K_I(i) \times \left(\sum_{i=1}^n TS_{ij} \right)} + \sqrt{K_o(i) \times \left(\sum_{j=1}^n TS_{ji} \right)}. \quad 14$$

4. CASE STUDY

We use an aerospace instrument product development (AIPD) project (Yang et al., 2014) to verify the proposed concepts and model. The AIPD project involves a large number of activities and teams. Since we focus on the impact of trust and the overlapping process on the communication and coordination among PD teams, we selected 20 teams (each team performs a unique activity) as summarized in Table 1. To measure the competence-based trust, we

need to capture the team's areas of expertise. In this case, the product-related expertise includes four areas, i.e., the power system (PS), environmental control systems (ECS), structural system (SS), and avionics (A). According to the process of aircraft development, we focus on the three areas of process-related expertise: requirements analysis (RA), integration and verification (IV), design (D).

Table 2. The duration of activities performed by teams in different expertise areas

ID#	Teams	Activity Durations (hours)	Product-related expertise				Process-related expertise		
			PS	SS	ECS	A	RA	D	IV
1A	Market analysis	16	4	5	3	4	12	4	0
2B	Requirements identification	13	3	4	3	3	10	3	0
3C	Perform function design	9	2	3	2	2	7	2	0
4D	System-level design	20	1	15	2	2	2	18	0
5E	Product configuration design	21	5	6	5	5	0	16	5
6F	Develop Verification scheme	18	4	5	4	5	0	14	4
7G	Perform shape design	17	0	15	2	0	2	15	0
8H	Perform concept analysis	16	4	5	4	3	12	4	0
9I	Confirm scheme	20	5	6	4	5	15	5	0
10J	Perform load analysis	9	1	8	0	0	1	8	0
11K	Die design	33	2	26	3	2	3	30	0
12L	Airfoil design	30	2	25	0	3	3	27	0
13M	Perform aerodynamic design	16	1	13	2	0	2	14	0
14N	Perform structural design	11	1	8	1	1	1	10	0
15O	Cabin design	48	3	38	5	2	5	43	0
16P	Propulsion system design	16	0	12	4	0	2	14	0
17Q	System assembly	10	2	3	2	3	0	2	8
18R	Perform wind tests	19	1	14	2	2	0	10	9
19S	Test & Verification	36	9	9	9	0	9	27	
20T	Airworthiness certification	51	12	13	13	1	0	12	39

Based on the interview responses, we calculated tie strength based on trust and dependency using Equations (1)-(12). Next, we applied improved K-shell procedure in MATLAB® 18 software. Finally, we get the value of improved K-shell of each team with equation (13): 641.77, 715.04, 666.44, 1190.01, 1057.73, 960.36, 917.16, 856.95, 892.61, 716.91, 693.53, 648.56, 696.94, 707.4, 650.23, 462.74, 507.87, 597.69, 657.69, and 546.4.

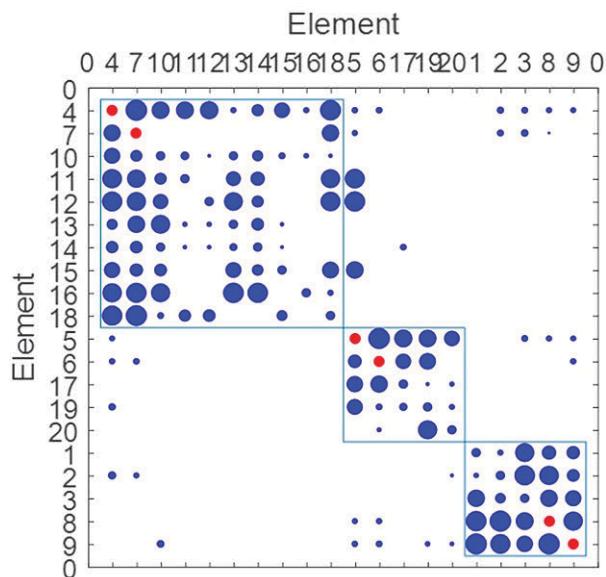


Figure 3. Clustered tie strength and the core teams

We use the two stages clustering algorithm proposed by Yang et al (2014) to cluster the tie strength. According the clustering results, the 20 teams are organized in 4 Groups. We then selected the K-shell value greater than 800 as the core team, which are team 4,7,5,6,8,9, as shown by the red dot in the Figure 3. This means that core teams which are trusted in the organizational network are highly trusted in their group. Core teams can perform on behalf of a group is to extend a link to another group and serve as a broker. Core teams that share knowledge and are close to each other in the group have high trust among them, which means that trust affects the structuring in organizations is by the es-

tablishment of core teams (McEvily et al., 2003). So, they are more important in the organizational network with great trust and influence.

5. CONCLUSION

In this paper, we propose a novel trust model from the perspective of social network in the context of product development organization, and then find the network-level trust of a team. The use of trust and dependency model to measure the tie strength between PD teams provides a fresh approach. This study suggests that it is significant for PD teams to try to enhance trust in the partner by utilizing competence and frequent interaction because trust can affect tie strength among teams. Based on the results, we can get mostly trusted teams in the organizational network.

The main limitations of this research are: (1) further, we encourage future studies to investigate the tie strength between and innovation in a broader range of processes; (2) trust is a multidimensional concept and by nature an ambiguous, so it is difficult to study trust with rigor.

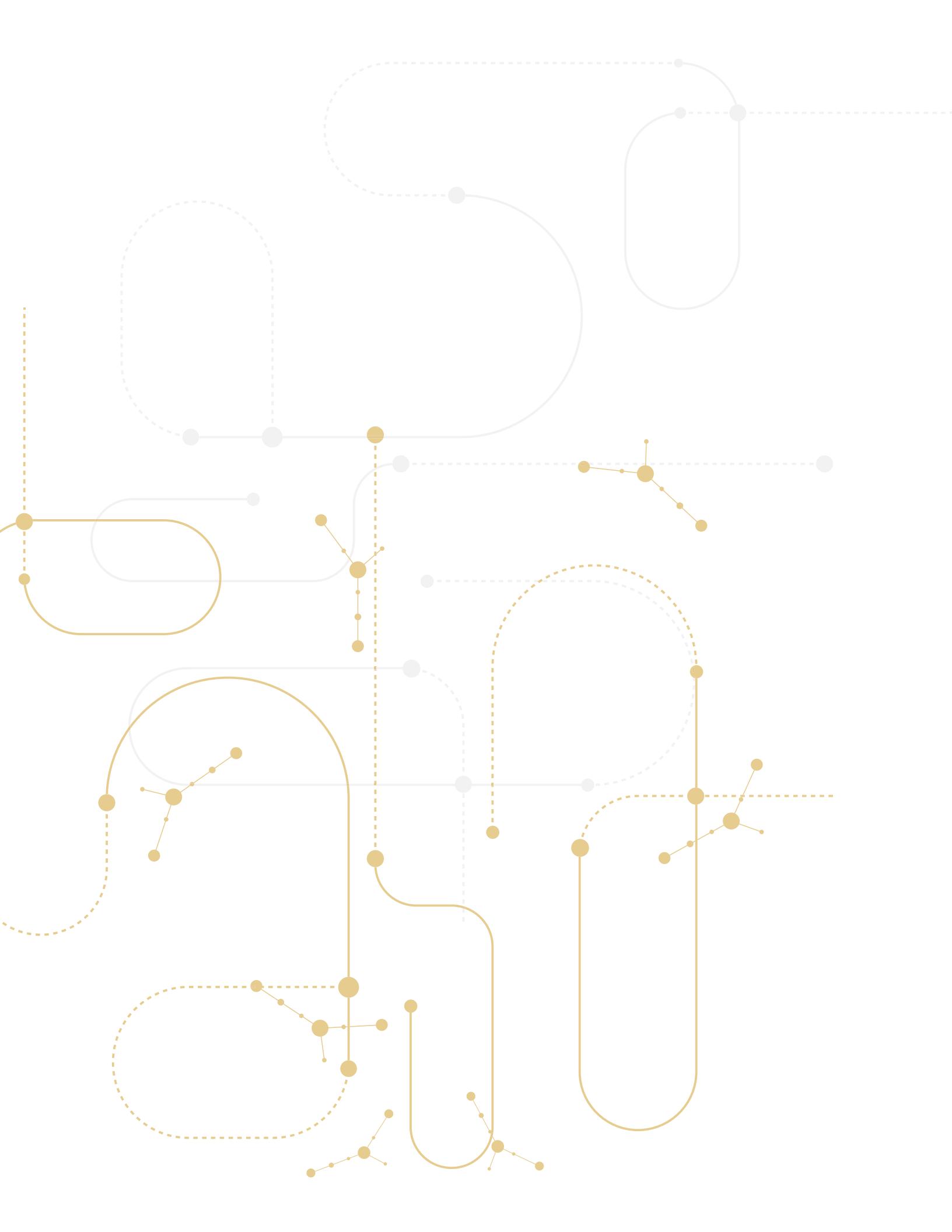
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Stakeholders' Trust and Power Dynamic in Tourism Resort Projects in a Developing Country

ABSTRACT

The inadequacy of the 'iron triangle' measurement of project performance has led to the increasing importance of the stakeholder's role in defining project success (Atkinson, 1999, Davis, 2017). Project evaluation goes through different phases, each having its stakeholders, success criteria and factors (Elbaz and Spang, 2018). When it comes to evaluating the long-term benefits of projects, stakeholder's reliance on each other to achieve success grows significantly. This leads to exchanges, both tangible and non-tangible between the stakeholders to ensure project success. The importance of trust and power that shape the exchanges between the stakeholders play an essential role in defining the overall project performance.

Tourism resort projects involve different stakeholders where the outcomes are determined by the level of satisfaction of a complex set of stakeholder's interests. The complexity of the stakeholders is context-specific that is influenced by the trust between and power of each stakeholder. When it comes to Oman, a developing country with a monarchy government-system, public power is low due to lack of resources ownership and political participation. On the contrary, public trust in government is high with high expectancy that the government works on the best interest of its people. However, as the country is facing challenges with low-oil prices led to introducing measures affecting people life, the public trust in government institutions found to impact their power negatively. Public power is triggered to increases when trust decreases, which could cause potential instability in the country.

Keywords: Project Success; Stakeholders; Social Exchange Theory; Trust; Power

1. INTRODUCTION

Despite the perceived high failures of projects (Davis, 2014), PM is a growing profession as demonstrated by an expanding body of professional associations, research, standards, methodologies, and tools seeking to reduce projects' failures (Albert et al., 2017, Davis, 2014). Projects are viewed as a means of generating values and achieving goals (Tillmann et al., 2012), and many organizations are embarking on PM to achieve their strategic goals (Bredillet, 2005). The success school of thought has been one of the most researched topics within the PM literature (Ika, 2009). However, the classification of a project to be successful or failure is subjective to the extent that can be said that success is "in the eyes of the beholder" (Müller and Jugdev, 2012).

Tourism resort projects are built in attractive locations to cater to specific purposes and are favoured by many tourism destinations. The resorts involve multiple stakeholders that need to work together and exchange resources to ensure overall success. In the case of Oman, circa 60% of newly planned development are resorts as the country paves its way to diversify its oil-based economy. The stakeholder's roles and power differ according to their rights and resource's ownership. The varying level of powers determines the extent each stakeholder group's interest is catered for and impact the trust between the stakeholders. For example, investors power is expected to be high as they have money, expertise, and other resources and trust with the government need to be high for this long-term relationship.

2. PROJECT SUCCESS

Project success has been a central topic in PM literature, and several attempts have been made to define what success is (Albert et al., 2017) without reaching a consensus on its definition (Ika, 2009, Davis, 2014). Davis (2014) examined twenty-nine related articles and came up with twenty-two different definitions for it. Perceptions on project success have progressed over time to embrace definitions that reflect success over the project lifecycle rather than the early research of limiting the success to the implementation phase of PM. Moreover, there is a growing consensus on the importance of involving multiple stakeholders for the evaluation of project success (Di Maddaloni and Davis, 2018). Project evaluation ought to be considered as an ongoing process of value creation instead of the traditional project output measurement (Eskerod and Ang, 2017).

Müller and Turner (2007) debate that the evaluation of project success is inconsistent since project definitions and methodologies can neglect the generation and realization of benefits. These definitions of the project focus on the project deliverables, instead of realizing the project-intended benefits (Ashurst et al., 2008). Consequently, the efficiency of the process becomes a more important criterion than the effectiveness of the investment and the realisation of benefits (Zwikael and Smyrk, 2012). This is in line with the classical project life cycle phases that consists of four stages: initiating, planning, executing, monitoring, and controlling and closing (PMI, 2017). Both of which ignore the long-term effects that projects usually produce (Eduardo Yamasaki Sato and de Freitas Chagas Jr, 2014).

Priemus (2010) model, which comprises of five stages spanning from problem analysis to the post-project operations offers an alternative to the project lifecycle model. This model has an advantage that it includes the time after project completion. Fahri et al. (2015) suggest that a project close-out phase is essential when assessing project success as it considers the project's benefits. The expansion of the project definition brings about the notion of benefits, outcomes, and outputs and the necessity to distinguish between their meaning to design appropriate success evaluation criteria (Nogeste and Walker, 2005). As per Zwikael and Smyrk (2012), the outputs are the products from the project, the outcomes are the 'measurable end-effect that arises when stakeholders realize the outputs from a project,'

and the benefits are the 'flow of value' from utilizing the outcomes.

While some success criteria and factors are universal across industries, there are distinctive criteria that are particular to projects in specific sectors (Cserháti and Szabó, 2014, Khan et al., 2013). Morris and Geraldí (2011) argued that it is imperative to focus on the context of the project rather than treating projects in isolation. Success can be interpreted differently across industries, whether it is carried out by the private or public sector and in a developed or a developing country. The tourism industry is one of the most project commissioners in recent years (Lebe and Vrecko, 2014).

3. TOURISM RESORTS

Tourism is of significant economic and social prominence (Wall and Mathieson, 2006). With the attractive potential impact of tourism on long-run economic development; governments are investing in the development of their destination to attract tourists (Alhowaish, 2016). Governments have developed policies to enhance the sector, enabling international companies to invest (Uysal et al., 2012) and develop new tourist attractions. However, despite the positive perceptions of the impacts of tourism, there are also concerns that tourism can have negative impacts on the quality of life of the host community (Nunkoo, 2017). There is substantial literature about the different effects of tourism on the economy, the environment, the society, and the culture, with researchers reporting both positive and negative impacts in each category (Wall and Mathieson, 2006, Liu and Li, 2018). It is argued though that the tourism impact get exaggerated for different reasons (Pratt and Tolkach, 2018), so it is challenging to have a realistic understanding of the effects. This may be due to the different variables that influence the interpretations of the tourism impact such as demography such as education level and gender, distance from the tourism development and stage of tourism development (Liu and Li, 2018).

Resort tourism has become a vital form of tourism in many countries (Agarwal, 2002). It has been favoured as a way to generate cash flow and sustain the economy in the long-run. Governments view such developments as an approach to improve the well-being of its residents through job creation, and increasing income (Anthony, 1997) and investors

see resorts as a way to maximize their profits. Resorts are not only accommodation hotels but full attractions (Inbakaran et al., 2012). Brey (2011) has developed a definition with the minimum qualification for a resort and proposed a classification system for them that includes lodging facilities as well as a range of amenities and recreation activities. Brey's definition of 'resort' will be used in this research as it recognizes the industry standards and it caters for descriptions of resorts mentioned by Inbakaran et al. (2012) and Naidoo and Pearce (2018).

Tourism resorts success is long-term outcomes and benefits rather than output driven. It involves multiple stakeholders, each with a subjectively constructed perceptions of success. The stakeholders of tourism resorts vary according to many factors, and the country settings impose a particular limitation on the role of the stakeholders. This research is focusing on the host community stakeholders' perspectives instead of the full list of stakeholders that tourism developments involve as they are concerned with the long-term impacts of the developments as compared to visitors who are generally after shorter term implications. The research has selected Oman, a developing country, to conduct the research. Developing countries have their challenges and specificities that require to be researched where both of PM and tourism have been criticised of focusing research in developed countries (Khan et al., 2013, Nunkoo, 2015).

4. CASE OF OMAN

Oman is a developing country with GDP in 2015 of about USD 70 billion, the majority of which is from the oil sector (Khan and Krishnamurthy, 2016). Oil is the backbone of the economy, contributing a large percentage of the country GDP; however, its amount is considered modest compared to country's neighbours (BTI, 2018). Oman is considered to be a 'rentier state' where it mainly depends on natural resources for the most substantial part of its GDP (Colombo, 2017). However, with the repetitive oil crisis, the country strives to diversify its economy and tourism is viewed as a mean to diversify the economy and provide employment where the unemployment rate is increasing (Alhowaish, 2016).

The government in Oman dominates the decision-making process at almost all levels. Besides, the government owns the natural resources such as oil and land. There is limited

social or political pluralism, and political parties are not allowed. Moreover, public participation in planning and development is limited as the government informs the local people about the project to be implemented, sometimes even after securing investors and assigning contractors. However, there are some attempts to increase public participation in government demonstrated the establishment of Majlis A Shura; A publicly elected council with some legislative responsibilities. The country's arrangement poses specific settings on stakeholder's roles and powers, which is essential in understanding how tourism resort projects are evaluated from multiple stakeholder's viewpoints.

5. THE USE OF SOCIAL EXCHANGE THEORY (SET)

SET has been prominent in sociology and social psychology literature and is known to be one of the oldest theories of social behaviour as well as it is considered to be the most influential conceptual paradigms in organizational behaviour (Cropanzano and Mitchell, 2005). Although different views of social exchange have developed, scholars agree that SET involves multiple interactions and obligations. The need for the exchange is created by the lack of resources, motivating actors to engage in obtaining valued inputs (Gottschalk and Solli-Sæther, 2005). These resources can be combined in different forms, such as economic and socioemotional (Cropanzano and Mitchell, 2005) or tangible and intangible (Scholtz and Slabbert, 2016). The economic or tangible exchanges tend to involve financial needs or pose physical property whereas the socioemotional or intangible address the social and esteem needs and does not have a physical presence (Scholtz and Slabbert, 2016, Cropanzano and Mitchell, 2005).

The main exchange norms highlighted in literature are the reciprocity and negotiation rules (Cropanzano and Mitchell, 2005, Wang et al., 2019). Reciprocity is defined as interdependent exchanges (outcomes are based on a combination of actors' efforts), a folk belief (involves the cultural element that people get what they deserve), and a moral norm (actors who do not comply with the guidelines are punished (Cropanzano and Mitchell, 2005). Negotiation rules can be understood in that transaction parties negotiate to achieve beneficial arrangements (Cropanzano and Mitchell, 2005). Control and trust mechanisms are used to resolve inter-or-

ganizational conflicts and reduce opportunistic behaviours (Wang et al., 2019). Trust, however, has more significance in resolving uncertainty in relationships as there are limits to what can be controlled through contracts (Herko and Han-na, 2017).

5.1 Trust between stakeholders

Trust is covered in a wide range of disciplines such as psychology, sociology, economics, organizational science (Guo et al., 2013). Its definition varies across these disciplines, where researchers in each subject attach importance to different aspects of trust (Chen et al., 2017). Despite a plethora of research highlighting the importance of trust, the exact meaning of trust construct remains vague, which is demonstrated by the different definitions (Viviers and Theron, 2019). de Oliveira and Rabechini Jr (2019) preferred to define trust in terms of a cause and effect relationship where it is viewed as a positive response to an action performed by another actor. This signifies that trust has a futuristic feature that an actor would act in an expected and satisfying way. For this paper, trust is defined as a positive expectation and a willingness to act upon the words and intentions of an exchange partner (McAllister, 1995). This definition signifies the importance of 'words' and 'intentions' which play important role in Omani culture.

Trust between different stakeholders could develop based on the Hartman (2003) classification into a political or institutional trust. Political or institutional trust is based on the belief that the government will produce desired outcomes for the residents even with less scrutiny (Miller and Listhaug, 1990) or the "confidence that political institutions will not misuse power (Lühiste, 2006). For the government and residents relationship, trust works as a facilitator and is considered necessary for the sustainability of projects (Nunkoo et al., 2012). The resident's support of government policy decisions is a function of whether the government decisions meet their expectations (Nunkoo and Gursoy, 2017, Ma and Yang, 2014). Government economic and political results are an essential element of enhancing political positions (Nunkoo et al., 2013). Resident trust in the government could be a predictor for their overall satisfaction of any development (Nunkoo et al., 2011).

Governments; however, may not always work in the best interest of their people. Democratic governments may not

promote democratic process and ensure fair outcomes (Pastras and Bramwell, 2013), which affects the political trust (Nunkoo and Gursoy, 2017). Distrust could develop if residents feel that government institutions are not responsive or representative of their requirements (Torcal, 2014). In such cases, the public could exercise their rights recognized by the constitution that could lead to bringing down the government.

This may be different in authoritarian or monarchy settings where the level of respect to the government is a cultural characteristic of the society (Nunkoo and Gursoy, 2017). It is common to find attributes such as deference to authority, blind obedience, and overreliance on authorities in authoritarian government (Ma and Yang, 2014). These features can be linked to how society values develop through social learning, schools, and social and political relations (Solt, 2012). These values can influence political trust and loyalty in the authoritarian type government (Ma and Yang, 2014). Government occupies a significant representational status in an authoritarian society, and political trust is developed through people's emotional dependence on such authorities (Ma, 2007). Research evidence suggests that political trust is higher than world averages in an authoritarian society like China (Yang and Tang, 2010). This can also apply to other Asian nations with similar settings (Ma and Yang, 2014). The relationship between public trust and power is not very clear. Some literature asserts that a direct relationship exists between them, where a higher level of public power corresponds to a higher level of trust in government (Nunkoo and Ramkissoon, 2012).

5.2 Stakeholder's power

The power allocation between different actors determines their position in any exchange situations. Nunkoo (2016) asserts that the higher the resources controlled by an actor, the greater his/her level of power. Also, Ap (1992) notes that "power is vested in the number and availability of valued resources that may be used as concessions to influence another". Actors with less power may end up accepting less than what they wish or deserve (Beritelli et al., 2014). Whereas the government and private sector powers are linked to resources ownership: public power varies across countries. In developed countries, the power of the public is obtained by different resources, including their right to select the government. Failure to engage with public stakeholders, in

democratic settings, has led to public protests which were witnessed in many projects such as the twenty-year protests in Susa Valley against High-speed Rail connecting Italy to France (Hooper, 2012); and shopping mall construction in Turkey in 2013 (Letsch, 2013). These protests have a significant impact on the project process and costs.

On the other hand, the situation in the developing world as far as public participation is not as optimistic. For example, Sun et al. (2016) examined public participation in China and concluded that there is often no public participation during the planning and project decision stages. Li et al. (2012) claim that public participation in developing countries is at its 'infancy' where, for example, in China, public participation is limited to environmental impact assessments. It is not uncommon that some stakeholder groups are ignored or marginalized by others (Bowen et al., 2017). This is maybe due to the lack of resources that are controlled by the public or their ability to influence the government system by voting. Bowen et al. (2017) assert that before given the voting rights for people of Maldives, their power and participation was limited. Decisions are usually made to favour economic aspects rather than addressing social and environmental concerns (Zubair et al., 2011). Moreover, protesting is restricted, and the governments can quell protest as they are less prone to domestic and international blame (Girod et al., 2018). This especially true for the government with natural resources such as oil where the government is successful in controlling protest as their access to resources allow them closer ties with powerful external countries that would support in case of any unrest (Girod et al., 2018).

6. RESEARCH OBJECTIVES

This paper is part of a Ph.D. research that has investigated the long-term resort project success criteria and factors for the case of Oman. The focus of this article is on the power and trust dynamic for long-term success in the case of Oman. The research questions are:

- What is the resident role and power in tourism resort projects?
- What's the role of power and trust in shaping SET and their impact on project performance?

7. RESEARCH METHODOLOGY

Being exploratory, the research followed interpretative philosophy with the inductive approach. Two resort areas in Oman were examined to understand how stakeholders in different regions perceive resort success and the role of public trust and power.

For the data collection, a total of twenty-two participants from a host-community were interviewed in face-to-face semi-structured interviews. A mix of purposeful and controlled snowball sampling strategies was utilised to assist in selecting the participants relevant to the researched area. The interviews were conducted with multiple stakeholders representing different government ministries including one interview with a government minister, participants from investors and operators, residents and an NGO to increase the validity and reliability of the obtained data. Questions were asked to understand the importance of different stakeholder's roles in defining project long-term success. Also, participants were asked about their perception of resort project success.

As each qualitative research is unique, the analytical process is also unique (Patton, 2015). Once data is collected, the 'process of immersion' starts where the researcher becomes familiar with the dataset and looks for developing themes (Braun and Clarke, 2013) and reflect on them (Bazeley, 2013). The interactive nature of data collection allowed themes and categories to emerge while collecting the data (Corbin and Strauss, 2008). The research followed the process recommended by (Miles et al., 1994) to analyse the interview information through three parallel flows of actives: data reduction, data display, and data conclusion and verification. The data reduction aspects were conducted following Saldaña (2013) process of coding. The codes generated in this research were based on data instead of literature as there has not been, to researcher's knowledge, any similar research within PM, and the analysis was undertaken in two phases.

Coding is 'cyclical act' where it requires more than one attempt to enhance it (Saldaña, 2013). For this study, the researcher developed a two-phase data analysis strategy. The first phase examined the viewpoints of each participant on what were long-term the success factors and criteria for the resort projects as well as who are the important and relevant

stakeholders. The second phase compared and contrasted these viewpoints at both stakeholder group level and cross groups. The process moved from specific to general as suggested by Richards and Morse (2013) "categorizing is how we get 'up' from the diversity of data to the shapes of the data, the sorts of things represented. Concepts are how we get up to more general, higher level and more abstract constructs". The researcher ability to link interrelated themes and concepts leads to model or theory development (Corbin and Strauss, 2008).

8. RESEARCH RESULTS AND DISCUSSION

The resident's role was found to be increasing, especially with the impact of some external factors. Besides, when asked about each stakeholder's specific criteria and factors of project success, it was evident that all stakeholders need each other for the long-term success of the projects. Each stakeholder's criteria can be provided by other stakeholder groups individually or collectively.

8.1 Objectives one: residents roles

The research reveals that in the context of tourism resorts case of Oman, resident's role is gaining more importance and the government is trying to engage with the community at different stages of the projects life cycle which may not have been the case in earlier projects. "See the main stakeholder would be the community because if you are going do something there... you always need their buy-in, at the end of the day it is going to be in their community" Investor2. Sometimes the involvement of the community in such projects comes early, especially if there are certain modifications to the project location: "the investor was involved from the beginning of the project. There was a need to re-allocate some lands. This was done to avoid any problems to raise in the future" Government3. Literature has a plethora of research highlighting the importance of residents for tourism development (Bowen et al., 2017). It is argued that tourism success is dependent on the goodwill and cooperation of the communities as they are part of the product (Murphy, 2012). Failure to engage the communities or their perception that tourism development does not meet their expectations could lead to resistance and hostility, which could reduce the potential of the overall development (Jamal and Getz, 1995). According to Byrd (2003), host community

needs to be involved in planning and development and not only recipients of pre-set government tourism plans.

However, some of the residents claim that pre-project discussion with investor and government does not always take place, "it depends on the investors... In general, the locals do not get involved in the selection of the locations, only at a later stage when the development is announced" Residnet2. This raises a concern which is if the communities in Oman are considered to be essential stakeholders; why they are not getting involved at early stages of planning?

8.2 Resident's power

It is not clear though whether this change in government attitude toward more engagement with the public is personally driven or is an indication of changes in the government approach. The existing Ministry of Tourism (MOT) minister is very keen on involving the public, and the policy confirms that people viewpoints and participation has taken place. "The MOT, with the new Minister, have emphasised that the locals or the villagers of proposed project area are well informed about it" Government1. However, other government authorities' approaches toward public engagement are not clear and could be different. The increasing importance of public participation in tourism projects in Oman could be linked to several reasons (Figure 1) such as:

- The Arab Spring has put some pressure on governments in the Middle East; the long-standing belief that people cannot protest is not anymore applicable. Although the protests in Oman were limited and the government was able to control it by listening to some of the people demands; the fact that people went protesting on the streets signifies a change in people power. The government is becoming careful and trying to avoid any similar scenarios that could be uncontrolled, as was the case with other regional countries. Therefore, the government is trying to engage with people and consider their opinions on different fronts, and tourism development is one of them to minimize the chances of confrontation. The small scale protest that has happened at one of the resorts was another example that unsatisfied communities could get together to get their rights. The protest demonstrated that dissatisfied communities could be a barrier to any developments.

- Tourism is considered to be a people industry where tourists usually interact with host communities to obtain new experiences. Research highlights the importance of resident's acceptance of tourism in vital (Scholtz and Slabbert, 2018). Lack of community participation is considered to be one of the factors leading to the high rate of failures for tourism plans (Yüksel and Yüksel, 2007). The government plans for diversifying the economy is vital for long-term government success; hence, the importance to involve the people to ensure the tourism diversification plans. Besides, the government tourism policy 2040 highlights the importance of the Omani culture and hospitality of the people, which in return requires their involvement in any development that ensures their satisfaction.
- The country's historical background of civil wars and unrest took place up to the 1970s, still pose a threat to the government. Besides, the social structure and the tribal system power still a way to attract people loyalties. It was mentioned in one of the interviews with the residents at resort project that the cities in Oman that had a history of civil unrest, had more consultation about the tourism projects developed in their area and hence more benefits.
- The social media has created new platforms where people have more space to express their views, which could spread widely and sometime without governmental control. This space, although controlled by the government, still pose a threat that has the potential to erupt at any point. The significant advancement in media and commu-

nication is attributed to be one of the factors that have caused political unrest and Arab spring (Al-Shamsi, 2015).

8.2.1 Conditional power

The power indorsed to the residents, although maybe a step in the right direction, is only a conditional power where it can be withdrawn whenever the conditions change. The public power can either increase or decrease depending on both the government and the public and could vary from an area to another within the country. Some sources of power for the public are in Figure 1. One of the residents highlighted that when the same developer built a resort in a different area of the country, residents in this area gained more benefits, and that was due to their power. "Once the resort project was initiated, the community forced the developer to provide certain requirements; they are from that area. So, they asked the developer, if you want to take this land, you must provide something in return to the community" Resident1. Considering the historical context of the country, it is expected that residents of areas that witnessed a civil war against the government are treated differently to ensure their satisfaction. Besides, as the tribal system is still influential in Oman, the government maintains its legitimacy by the support of the tribal leaders (Worrall, 2012) and therefore, ensures that vital tribal leaders are satisfied. This is vital to minimize the likely event of going for protests that could destabilise the country.

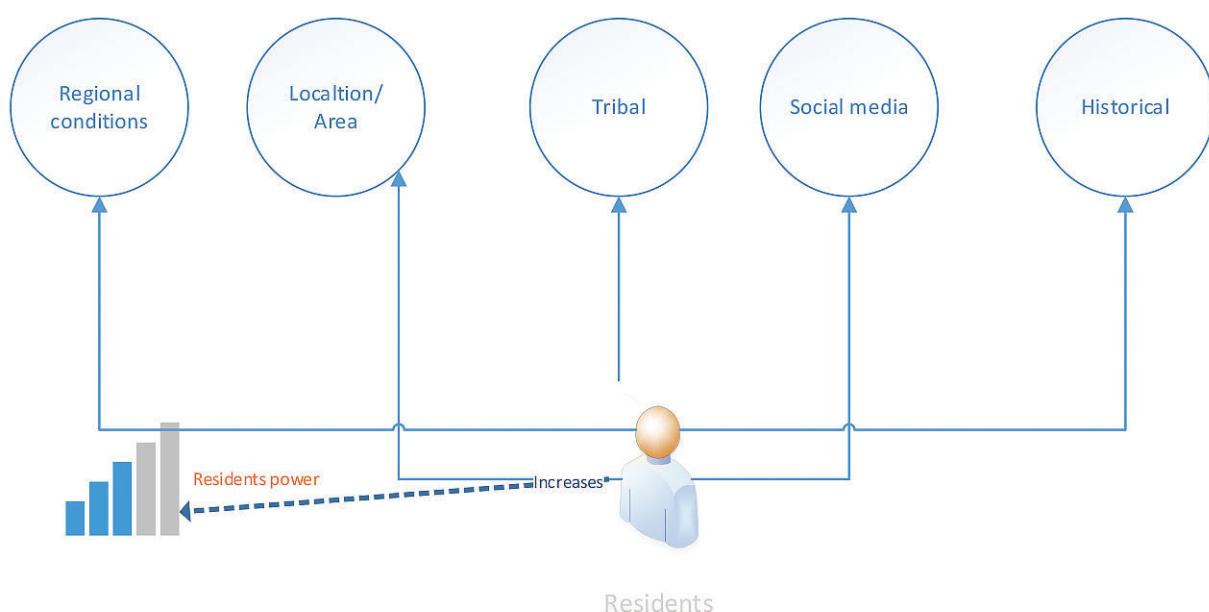


Figure 1. Residents sources of power

8.3 Objective two: SET with trust and power in tourism projects in Oman:

SET has been used in different settings of exchanges; however, this research used it in understanding how exchanges between stakeholders shape project evaluation. It was identified that the government, private sector, and residents are the key stakeholders from the host community perspective for Oman. The government power can be linked to its ownership of the resources and planning of the tourism sector. The private sector is considered as the primary driver of investment in tourism, where the government expects 88% of the capital investment in the 2040 vision to be conducted through the private sector. The resident's power is conditional as described in the previous section, where it varies across cities and subjective to regional development and other factors.

The trust element between the exchange partners varies depending on the type of exchange. The government relationship with the private sector has both aspects of trust and control where control is managed through contract or a different kind of agreements. However, as it is challenging to cover all future uncertainties by control the measures, trust plays a higher role between the two stakeholders to nurture the relationships. The government relationship with the residents is based on political trust, which is mainly derived from the political and social characteristics of the Omani society. Omanis developed an appreciation for the Sultan whose family has ruled the country for more than 250 years. The

significant improvement the country witnessed since 1970 has built considerable trust with the Sultan. However, this trust was shaken by the Arab spring movement started in 2011, where some protests took place in several cities. Although the protestors have chanted that the Sultan authority is untouched and still trusted, specific government figures who were linked to corruption were requested to be removed.

As far as SET norms, the results demonstrate that in the tourism projects in Oman, reciprocity, as well as negotiation aspects of social exchange, takes place. Besides, both control and trust play roles in forming these exchanges. The residents; having a conditional power within the stakeholders, can only use trust when involving with any exchanges with government or indirectly with investors/operators. Also, the government role is both as an actor and is mediating between two stakeholder groups. The nature of exchanges can be explained as follows and shown in Figure 2:

- Government vs. private sector: SET is characterised mainly by negotiations norms with controls in the forms of contractual agreement outlining each party's expectations and roles. Moreover, there is always elements of reciprocity norms and trust as negotiations contractual agreements cannot cover all the future uncertainties. Hence trust plays a vital role in the relationship as well.
- Government vs. residents: SET is utilized with the reciprocity approach, where political trust is vital in the success of the relationship. The government provides

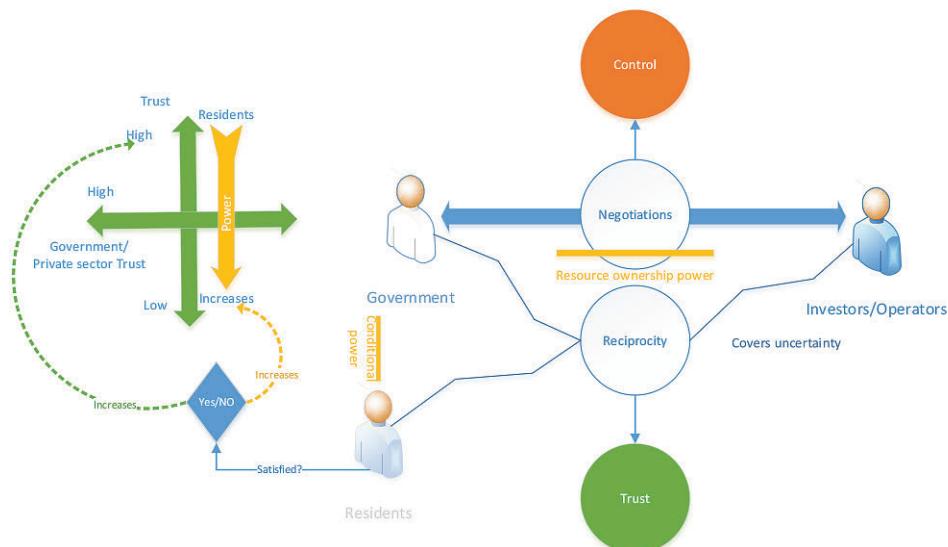


Figure 2. Settings of Social exchange theory for resort projects in Oman

certain services, infrastructure, and laws to ensure the investors support the community. In return, the community support both the private sector and the tourists.

- Private sector vs. residents: the government is representing the interests of the residents; the relationship between private and residents is based on reciprocity where each needs the other for the success of the project. Trust plays a significant role in this relationship where the support for the project and tourists is linked to benefits received from the project. Residents will support the project when the resort meets their expectations of improving the quality of life at the community.

The resident's power varies according to their trust in both government and the private sector. If the residents are satisfied, then their trust to both government and private sectors is at high which does not require them to seek power. If for any reason, residents are not satisfied with the development, then they will attempt to obtain more power through protesting or other means which may harm the development. The extent of the power and impact on the development the residents could do is not clear for Oman, but certainly having unpleasant results.

9. CONTRIBUTIONS AND CONCLUSION

The research contribution to PM literature is in twofold. First, it has identified the roles and power stakeholders in the context of tourism, and the case of developing country, areas that have a lack of research. Second, it has utilized SET as

a platform to understand how evaluation develops for the long-term aspects of project success. Besides, it integrated both elements of trust between stakeholders and their power into the model.

The long-term success criteria and factors are a function of exchanges between the stakeholders where, in optimal conditions, every stakeholder gain and perceive the project as a success. However, the optimal conditions do not always exist for several reasons, and the elements of power and trust between the stakeholders play a significant role in determining the outcomes of the projects.

The model developed for Oman recognizes the importance of every stakeholder's requirement to define the project as a success. While the power of the government and the private sector is undisputed, the conditional resident's power plays a role in deciding the final results of the projects. The conditional power of the residents relates negatively to the trust residents put in the government. The resident's political trust is usually high, can be lessened if residents do not receive the expected outcomes of the development. In such cases, and energised by other factors, the residents could pursue higher powers to pressure both the government and the private sectors. The extent of the impact of public power is unknown but can be catastrophic.

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“The Last Area Of Freedom” Theories for Explaining the Lack of Trust in Major and Mega Projects

ABSTRACT

Several research studies show that despite the enormous investments in project management education and training within the last twenty years, neither the success rates of projects nor the productivity in the management of the projects did significantly improve.

Research in the last years aimed to understanding the reasons for the situation. This is a reasonable endeavor as the number of projects is steadily increasing, project, program and portfolio success gains both microeconomic and macroeconomic importance. Yet we lack a deeper understanding of the underlying principles and mechanisms in projects, as projects consume more resources and time and meet fewer requirements than expected.

In this conceptual paper we combine the micro- and macroeconomic view on productivity in the project-based work. We argue that the Transaction Cost Theory and the Principal-Agent Theory provide valuable frameworks for the lack of trust and as a further consequence a lack of productivity in projects. Project management research has not examined all behavior types presented in the Transaction Cost Theory and the Principal-Agent Theory. Particularly individual opportunism is not sufficiently researched and might offer new insights in the behavior of people working in projects.

Keywords: Productivity in Projects; Trust; Opportunism; Principal Agent Theory; Transaction Cost Theory

1. INTRODUCTION

Since the 1980s the economic growth of the Western countries has been low, it is about 0.5-2.5% p.a. in relation to emerging economies which are growing by 7-10% by year. This slow economic growth is despite intense rationalization and efficiency enhancement measures in all economic areas (e.g. driven by the lean management approach). The projectification studies in Western economies show that project work today accounts for 25-35 % of the total economic activities and will further increase towards more than 40 % within the next years (Schoper et al 2018). If a third of the national GDP is generated by project-based work, then we must better understand this increasingly important economic area and better manage it to increase the productivity of projects, programs and portfolios (PPP) which again builds the basis for future macro-economic growth.

But despite the many success studies in project management in the last decades (e.g. Cooke-Davies, 2002) and the large investments in project management training and certification worldwide, the failure rates of projects are continuously very high: The recent studies from the CHAOS report state that less than a third of all projects are completed in time and in budget (Standish Group, 2017). Flyvbjerg showed that more than 90% of the global infrastructure projects are either delayed or beyond budget (Flyvbjerg, 2011). The Gartner report states that 75% of all ERP projects fail despite the IT industry's focus on better customer service and IT systems (Gartner, 2016). The PMI annual report states that for every billion USD invested in the USA, 97 million USD is wasted due to poor project performance (PMI, 2017).

In this conceptual paper the author tries to find an explanation for this unsatisfactory situation.

As a consequence the research questions in this conceptual paper are:

1. What causes this lack of trust in projects?
2. What theories could offer an explanation for the lack of productivity in project management?
3. Could it be possible that the lack of trust in projects and the lack of productivity in projects are linked with each other?

As a consequence this paper analyses both the Transaction Cost Theory and the Principal Agent Theory for gaining a better understanding of the reasons for the lack of productivity increase in project management.

2. PRODUCTIVITY IN PROJECT MANAGEMENT

Productivity was first defined as efficiency of a person, a machine, a factory, an industry or an economy, measured in terms of output per time and resource spent. This definition can also be applied for projects. However in the last decade, possibly as a consequence of the Global Financial Crisis in 2008, the focus of shifted towards more intangible project outcomes, a better impact or strategic value of projects when considering their contribution on program and portfolio management (apm, 2018). In addition to improving the ratio of output : input, the policy discourse shifted to a focus on this new holistic productivity. This general strategic shift towards a productivity increase can be observed both in the OECD report "The Future of Productivity" (OECD, 2015) as well as in the UK in their "productivity conundrum" report by the Department of Business, Energy and Industrial Strategy (BEIS, 2017).

Chan & Ejohwomu analysed in a literature review 146 articles that explored the relationship between PPP (project, program and portfolio) management and productivity (Chan & Ejohwomu, 2018). The papers deal with two major themes: factors that affect project management productivity and ways of measuring productivity in projects. Inhere Chan & Ejohwomu show that there is no general framework to assess PPP management productivity. None of the papers analyses the reasons for the lack of productivity in PPP manage-

ment or shows new ways for decisive improvements in productivity and effectiveness in PPP management.

What is missing in project management is a productivity increase movement similar to the one in operations management that started in the 1990s with the introduction of lean management. This initiative lead to an average annual productivity increase of 2,7% p.a. in the car industry and 7,4% p.a. in the telecommunication industry in the decade between 2005 and 2015 (Rothgang et al, 2018). Compared to the annual macro-economic growth rates of the Western industries of 0,5-2% such growth rates of 3-7% per year are high. If a third to a half of the national value creation is taking place in the form of projects, then a productivity increase of 3-7% could create a macroeconomic growth rate of up to 3,5% per year. Most of the Western economies have not seen such growth rates in the last decades.

Despite the growing importance of project-based work and its increasing contribution to economic development, the link between project management and productivity is "surprisingly under-researched" (Chan & Ejohwomu, 2018). Pollack and Adler argue that the relationship between project management and productivity is often assumed, yet "this assumption typically remains unexamined" (Pollack & Adler, 2014).

3. SITUATION IN EXTERNAL AND INTERNAL PROJECTS

Projects are an omnipresent phenomenon of today's time. As a consequence different projects types are differentiated, depending on the budget size, duration, the aim and scope, the industry, the degree of novelty and other factors. In this paper the author differentiates between internal and external projects. The projectification study showed that about 84% of all projects are internal projects (like marketing, sales, ITC, organisational or product development), and only 16% are external customer-based project (Schoper et al, 2018).

The characteristics of external projects are as follows: there is a tender or a pitch by the principal and the supplier with the most attractive offer (meaning in most cases with the cheapest price) will be awarded with the contract. In industries such as construction, IT or automotive the cost calculation of the supplier is in many cases unrealistic and there-

fore the offer is lower than the cost in order to underbid the competition and to win the tender. The unpronounced estimation of the supplier is that there will be future change requests by the principal during the course of the project, when the bargaining power is weaker and the dependency of the principal on the supplier is high, so that the supplier then gets the price he needs to cover all expenses and to make a profit. These typical behaviors, both by the principals and the suppliers are one explanation for the continuous cost overruns of external projects. These behaviors of both parties continuously decrease the level of trust between the two contract partners.

Internal projects differ from external projects in an important respect: the principal is in many cases the top management who want their strategy to get implemented in the form of a project; this can be a new product that shall be developed, or a new marketing campaign or a new IT system to be installed. There is no tender or a pitch and no internal competition between the project teams. So why do these internal projects not meet their budget and time objectives although their premises differ completely from external projects? Why are these internal projects also not productive? An explanation could be that because of the uniqueness of the non-repetitive tasks the project team has to estimate the work packages necessary to execute the assignment, but this is done for the ideal case. There is no internal benchmarking of the project plans. One assumption is that these project plans are not realistic, that "we tend to be too optimistic; overstating the project benefits, underestimating project costs and miscalculating the likelihood of project success" (Ika & Sönderlund, 2016). Nobel prize winner Kahneman (2003) identified the main bias in forecasting: the optimism bias, the systematic tendency to be too optimistic about the outcome. In addition the efforts for internal communication and close coordination among the team members are not sufficiently considered in the project budget plans, neither any work breaks, interruptions, disturbance, waiting time, inquiries, rework, lack of qualification or set-up times (these are defined as the "7 areas of wasting" in the lean production philosophy). As a consequence the author concludes that because of the over-optimistic planning, the optimistic bias in forecasting and the disregard of waste, internal projects are not meeting their time and budget targets.

As a consequence the organizations react to the phenomenon of not meeting the budget and time targets by not trusting their internal project teams any more. They implement control mechanisms e.g. in form of standardized templates for regular project reporting, by the implementation of Enterprise Resource Planning systems and the measuring the project management by Key Performance Indicators like Earned Value, Cost and Schedule Variance aso. However this project control causes additional effort in the project teams. This additional effort is not part of the previous project budget and time plans. Another reason why projects are not meeting their goals or even fail is the fact of scarce internal resources. Specialists e.g. in IT, legal advice, product behaviour simulation or prototype building in the organisations are rare and most projects need the support of the same resources. As a consequence a project team has either to wait for the scarce resource which is one explanation for not meeting the deadlines, or they have to pay more than planned for overtime. However in the planning of the projects this potential obstacle of scarce resources is not considered sufficiently, which is another consequence of the optimistic bias.

4. TRUST IN PROJECTS

Rousseau defines trust as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another." (Rousseau, 1998, p. 395). Trust is considered vital for bringing farther-reaching co-operative processes. If trust is present, people can spontaneously engage in constructive interaction without pondering what hidden motives a partner might have, or the risk of disclosing information (Kadefors, 2004). Wicks et al. argue that there is an optimal level of trust in each situation, and that the more interdependency there is between exchange partners, the more trust is required so as to achieve efficiency and not miss opportunities for improvement. (Wicks, 1999).

Control can lead to the fact that the project staff feel that they are not trusted, this can have adverse consequences of a moral hazard nature. A lack of trust can produce a dynamic that serves to ratchet up control mechanisms', thus preventing success. Trust can spiral, both positively and negatively, what is needed is a balance between the use of controls and trust (Atkinson et al, 2006).

5. INTRODUCTION TO TRANSACTION COST THEORY

Transaction Cost Theory (TCT) is a part of the New Institutional Theory and is used to explain why certain transactions are processed and organized more or less efficiently in certain institutional arrangements. Ex-ante transaction costs, such as information, negotiation and contract costs are costs that occur before a contract is concluded. Ex-post transaction costs are costs like control, enforcement and subsequent contract adjustments that may occur after a contract has been concluded or services have been exchanged. A transaction can be defined as efficient when the actors choose an organisational form that has the lowest total production and transaction costs.

The idea that projects should be seen in institutional terms is not entirely novel for project management. Prominent project management scholars have already advocated the importance of institutional factors in projects (Dille and Söderlund, 2011; Engwall, 2003; Morris and Gerald, 2011; Miller and Hobbs, 2005).

Williamson (1993) distinguishes between three types of contractual relationships that constitute institutional forms of organisations: classic, neoclassic and relational.

In classic contracts the contractual conditions are fixed in advance, the transaction is of short duration and none of the partners expects subsequent adjustments to the contract. This is not the case in project management.

In neoclassical contracts the settlement is via long-term contracts. For these transactions the contractual partners cannot specify all conditions in advance in the contracts, therefore there is a need to anticipate adjustments. This is done by means of security, adjustment and guarantee clauses. Williamson calls this institutional arrangement "hybrid". External customer projects are typical representatives of these neoclassical hybrid contracts: not all conditions can be defined in these long-term work relationships, therefore the supplier relies on adjustments caused by the principal to compensate the disadvantage caused through the lack of bargaining power at the beginning of the relationship.

In relational contractual relationships complex social relationships require joint decisions by the transaction partners and coordinated adjustments and development. Internal projects are typical representatives of these relational contractual relationships.

This analysis of external and internal projects shows that the contractual relationships are different relationships constituting two different institutional forms of organisations.

The Market vs. Hierarchy model by Williamson (1996) in Figure 1 shows the relationships between possible institutional arrangements.

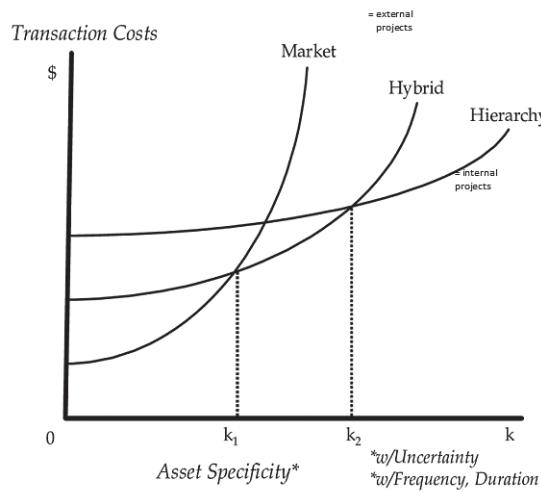


Figure 1. Transaction costs depending on the asset specificity,
Source: Williamson (1993)

The internal service provision i.e. the form of relational contractual relationship is called hierarchy, the hybrid organisational form is called network. Williamson states that an exchange of goods or services with low uncertainty and not associated with transaction-specific investments will be handled through the institutional arrangement "market" (see Fig. 1). Due to the large number of competitors an opportunistic behaviour by the contractual partner is restricted. A subsequent contract adjustment can be autonomously enforced by a contractual partner, for example by looking for a new provider. This market arrangement is not applicable for major or mega projects.

With the increasing dependence of the contracting parties because of the high transaction-specific investments, the incentives for the contracting parties increase to act opportunistic in order to acquire quasi-pensions. Here the "hybrid" organizational form is the suitable in which the contractual partners protect themselves from opportunistic behavior by agreeing information obligations or sanctions in the event of non-performance of the contract and anticipate possible renegotiation or adjustment costs. This is the case in classic external projects e.g. in the construction industry.

In the case of complex projects with high uncertainty and large transaction-specific investments the internal service provision "hierarchy" is suggested as the most effective institutional arrangement. The transaction costs for information procurement, negotiation and contract cost can be saved, and later adjustments are easier to handle internally. By the organisation's own management and control system opportunistic behaviour is supposed to be completely eliminated. This should be the case for all internal projects.

The goal of this model is to choose the organizational form in which the transaction costs are minimal and where the greatest possible efficiency of exchange and protection of investments is guaranteed. As a consequence organisations should choose for complex and uncertain assignments the organisational form "hierarchy" (meaning internal projects) and for less complex projects the "hybrid" organization (external projects). However in practice when companies search for expertise in complex projects (e.g. in IT) they look for external specialist support in the market. This is contradictory to what is suggested in TCT model and could be an explanation for the lack of trust between the two contractual partners in projects as well as for the continuous cost increase in complex projects.

6. PRINCIPAL-AGENT THEORY AND ITS APPLICATION IN PROJECTS

"By definition the agent has been selected for his specialized knowledge and the principal can never hope to completely check the agent's performance" (Arrow, 1968). This problem arises where the two parties have different interests and asymmetric information, in most cases it is the agent having more information, such that the principal cannot en-

sure that the agent is always acting in the principal's best interest. This is the basis assumption of the Principal-Agent Theory. It assumes certain assumptions in the behavior of the principal and the agent. Several analyses show that this theory can be applied for explaining the behaviour of the parties in projects (see Mahaney et al. (2003), Turner et al. (2004), Müller et al. (2005)).

The following are the typical root causes and behaviors of the principal and the agent and mechanisms to limit the consequences of these behaviors.

Limited rationality: Due to limitations in terms of the own capabilities, time, knowledge and processing capacity of information, both the principals and the agents can act rationally only to a limited extent. Uncertain future conditions have an influence on both contract partners as not all possible conditions can be specified contractually. This is particularly the case in all sorts of projects as these are "unique endeavours". The longer, larger, more innovative, more complex a project, the more uncertainty is in a project.

Opportunism: The economic actors pursue their own interests in the sense of maximizing their own benefit, and also try to deceive their partner when the contracting party lacks information to discover it. This includes delays caused by the supplier as well as lesser efforts to achieve the goals. There may be opportunistic behavior before and after the conclusion of a contract e.g. in the form of renegotiation based on asymmetric information distribution and thus the possibility of deception. The higher the degree of uncertainty of future conditions, the more difficult it is to define all conditions in a contract, which again leads to opportunistic behavior. The success of a transaction essentially depends on the propensity of the actors to opportunism. The smaller the number of actors, the greater is the tendency to opportunism (small numbers problem). This opportunistic behavior could be the explanation for the lack of productivity of projects.

Reputation is a specific capital that must be defended the more possibilities there are for opportunism. High reputation decreases the motivation for opportunistic behavior and reduces the information and negotiation cost.

Situations in which one of the cooperation partners is better informed than the other are characterized by asym-

metric information (Schleg, 2008). Information asymmetry happens when the principal and the agent are not in the possession of the same information at the same time. Therefore, the three types of information asymmetries apply: hidden characteristics, hidden information, and hidden intention. Hidden characteristics are associated with adverse selection and cause the selection problem before a contract is signed. It means that the principal does not have all information about the agent before the agent is hired. The adverse selection problem occurs in the early phases of the project. Hidden information or hidden action causes the moral hazard risk. This occurs after a contract is signed between the two parties. Hidden intentions can cause hold-up problems. The principal invests money and trusts that the contractor will cooperate, but what can happen is that the contractor behaves opportunistically. When the principal realizes that the agent is acting opportunistically, it can be too late for the principal to withdraw the investment. But also the opposite can happen. Measures to minimize these risks are controlling and monitoring. As both cause additional costs they are called "agency costs".

Uncertainty: A distinction is made between parametric uncertainty, which differentiates uncertainty about future environmental conditions, and behavioural uncertainty about the possible opportunistic behaviour of the partner. Both uncertainty factors contribute to the increase in transaction costs before and after the contractual agreement, since several environmental conditions and behavioural patterns must be foreseen and agreed upon and the limited rationality usually leads to later adjustments and renegotiations.

In order to limit the consequences Sharma (1997) suggests the self-control, client control (through the principal), bureaucratic control (by contracts) and common control.

The author examined the following five studies on the behaviors based on the principal agent relationship theory and their application in projects:

Zaghloul and Hartman analysed the contractual relationships in the Canadian construction industry, which are mainly based on confrontational situations that reflect the level of mistrust in contract documents. They state that this can be the driver for the increase of the total cost of specific projects and that this behavior affects the overall relation-

ship between the contracting parties (Zaghloul & Hartman, 2003).

Müller and Turner (2005) state that in the principal-agent relationship between the project owner and project manager both parties are aware of the uncertainty and lack of trust because of the information gap. They suggest a certain level of communication to improve the imbalance between principal and agent in projects.

The study of Mahaney & Lederer (2011) found that there is a negative relationship between shirking and project success, and between privately-held information and project success. They examined in particular the following sorts of shirking "Taking excessive breaks", "Taking long lunches", "surfing the Internet", "Sending e-mail jokes", "Talking on the phone", "Playing computer games" "Socializing" and "Calling in sick when healthy" in IT projects as well as the following forms of privately-held information "Openly discussed project problems in status reporting", "Openly provided their project knowledge", "Readily shared critical project status information", "Openly discussed problems they believed they could correct quickly", "Accurately reported project status", "Openly described issues to auditors", and "Reported task completion statuses that were unexaggerated". As far as the authors know this is the only research study in project management that analyse some forms of opportunism. Although not directly mentioned the authors suggest that these behaviors can be summarized as opportunistic and information hiding. In their conclusion Mahaney & Lederer suggest that monitoring may be a more effective way to improve the project outcome than promising to reward the agents for the outcome.

Ceric (2012) showed in a survey on the Croatian construction industry the relative importance of the relationships between the key project parties in construction projects in terms of the communication risks to minimize the risks through hidden information.

Li, Artidi & Wang (2014) found out in a study on US construction projects that the project owners believe that the transaction costs can be reduced if the owner and the contractor follow basic guidelines as experience in similar projects, prompt payment, good relationship with project participants, no irregularities in bidding, few material

substitutions and claims, if the project is well-run through technical competency, strong leadership, prompt decision-making, effective communication, fair conflict management, and if the transaction environment is favorable by fair risk allocation, early contractor involvement, and complete design documents. This behavior can be summarized as no intention or information hiding. The findings indicate that transaction costs are affected by the owner, the procurement method, the project delivery system, and the type of contract.

Table 1 summarises the findings of the five studies concerning the behaviors examined of project sponsors as principles and project managers as agents:

these sorts of corrective measures lead to less trust among each other and to more effort to satisfy the control needs, and as a consequence lead to less productivity and more administrative overhead. These consequences again reduce the productivity in projects.

7. SUMMARY & FUTURE RESEARCH

This conceptual paper tries to develop the relations between the reasons of the lack of trust in projects and as a consequence the lack of productivity in project management. The interrelationship between these factors can be summarized as follows:

Table 1. Analysis of existing studies on the assumptions of the Transactional Cost Theory on the behavior of project sponsors and project managers

	Zaghoul & Hartman (2003)	Müller & Turner (2004) 2005	Mahaney & Lederer (2011)	Ceric (2012)	Li, Artidi, Wang (2014)
Limited rationality					
Opportunism			(X)		
Fear of reputation loss					
Asymmetric information	X	X	X	X	X
Fear of uncertainty		X			

All five studies examined external customer projects, three of them in the construction industry, one in the IT industry and one in several industries. They show that particularly the asymmetric information in form of hidden intentions, hidden characteristics, hidden action, or hidden information seems to be applied frequently in external projects. However the other forms of behavior as limited rationality, opportunism, fear of reputation loss and fear of uncertainty are so far not (or just partly as in the case of opportunism) examined in the five studies. However none of the studies examined internal projects.

Sharma (1997) and Mahaney & Lederer (2011) suggest that close monitoring and control in the way of self-control, client control, bureaucratic control and common control are effective ways to improve the project outcome. However

The author concludes that the set of constraints of the Principal Agent Theory provides a good explanation for the lack of trust and as a consequence a lack of productivity in project management:

Opportunism of agent → lack of trust of principal → more control → less productivity

The literature analysis shows that only few studies analysed so far parts of the behaviors both of principals and agents. More holistic analyses both of external and internal projects could lead to a better understanding of the behaviors and relationships between the two actors and could give useful hints for understanding the lack of productivity improvement and the failure rates in projects.

The analysis of the characteristics of internal and external projects in the three organizational forms "market", "hybrid" and "hierarchy" of the Transaction Cost Economy Theory showed that the "hybrid" organizational form is the most suitable for external principal agent relationship projects and the "hierarchy" organization is the most suitable for internal projects with high uncertainty and large transaction-specific investments. However the authors doubt if this TCE model is consciously taken into account in organisations when assigning new projects. If this theory was applied consequently in practice this would mean that the most complex and uncertain assignments are to be managed as internal projects where opportunistic behaviour is supposed to be eliminated. This assumption needs to be tested in practice. If practice shows that this is not always case it could be a cause for the lack of productivity in projects.

The analysis of five research studies showed that not all aspects of the behavior of principals and agents in projects are analysed so far. Particularly the opportunistic behavior both of principals and agents in projects should further be examined. The deeper understanding of the various types of internal and external projects could give useful hints for

future more productive principal agent relationships. There is a need for more case study and qualitative research to understand how the stakeholders in projects influence and have an impact on the productivity of projects.

The paper concludes with the hypothesis: The lack of trust between the project cooperation partners is the reason for the lack of productivity in projects.

30 years after the introduction of lean management in organisations all line functions and operations management are continuously under control. Project management is perceived by many employees as the last remaining area of self-determined work and personal freedom in organisations on the micro level. This leads to opportunistic behaviors, to more control and as a consequence to reduced productivity in projects. As project work will increasingly become omnipresent work form, it is of crucial importance to gain a better understanding of the behaviors of the actors both in internal and in external projects, and to increase the mutual trust and therefore productivity in projects. So far we lack a model that connects these areas. A collection of data would be necessary to verify the new model.

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Interrelationships of the Critical Success Factors of BOT Projects in Iran: A Grey-DEMATEL Approach

ABSTRACT

The purpose of this study is to analysis interrelationship of critical success factors (CSFs) for implementing Build-Operate-Transfer (BOT) projects in Iran, using a Grey-based DEMATEL method. For this goal, primary CSFs extracted from the literature and sent to experts and practitioners through a questionnaire to select the most essential and relevant CSFs for BOT projects in Iran, which finally 39 factors were identified that grouped into seven main factors, supporting the existing literature. Then, to analyse and prioritize the interrelationship of these factors, an online questionnaire shared among Iranian instructors and professionals in this field, and finally, 40 completed questionnaires collected. To analyse interactions of factors in each group, first, experts' opinion (under uncertainty) stated in the system of Grey numbers and unified into a single opinion afterward. Subsequently, interrelationships of factors analysed with DEMATEL approach. The results show effectiveness, influence, and interrelationship of the critical success factors for BOT projects in Iran.

Keywords: BOT Projects; Critical Success Factors (CSFs); Grey DEMATEL; Interrelationships

1. INTRODUCTION

The build-operate-transfer (BOT) project has been extensively supported with the increasing demand for public infrastructure in the past decade (Wang *et al.*, 2019). Population increase and impressive economic growth lead to significant demand for public infrastructure, which is the basis of a sustainable and fruitful society (Shen *et al.*, 2011). BOT has been

increasingly crucial in presenting public infrastructure as an innovative method to mobilize private sector's funding, efficient management, and technology (Xu *et al.*, 2012). BOT defined as an arrangement of contract in which the private sector finances a public infrastructure's design, construction, operation, and maintenance for a particular concession period, and at the end of it transfers the ownership to the government (Sarvari *et al.*, 2019). Several types of research demonstrate that government-sponsored BOT projects motivate the private sector to take part in public infrastructure schemes (Dias and Ioannou, 1995; Liddle, 1997). However, the route to a successful BOT contract is not quite facile. The entire project development process is a lengthy, expensive, and complicated business. The competition is intense, financial risk is high, negotiations are expansive, and opportunity costs are high (Huang and Dzeng, 2019). Thus, BOT contracts must comprise calculated risks, attitude flexibility, and adaptable proposals to uncertain circumstances. Both government and bidders must consider these concerns in accepting/proposing BOT proposals. It is also essential that they recognize the critical success factors (CSFs) to be successful in BOT contracts (Tiong *et al.*, 1992). In the ground of BOT projects, CSFs are those features of the bid that when correctly sustained and managed have a considerable effect on a successful BOT contract. In other words, CSFs are those criteria that must be given specific and successive attention because they can increase the project sponsors' chances of preserving the contract proficiently (Tiong *et al.*, 1992). The concept of CSF could put in an application for three main objectives comprising the project itself; the consortium that sponsors the project; and the economic, political, and social environments of the project location. Strengths at any of these domains can affect the chances of a successful outcome (Tiong *et al.*, 1992).

Therefore, it is so important to identify critical success factors and develop theories for efficient and effective implementation of BOT projects in developing countries such as Iran. Surprisingly, few studies have been identified the critical success factors towards implementing the BOT system in Iran considering their interrelationships. Thus, to fill this research gap, this paper identifies and evaluates the critical success factors related to BOT projects in Iran. To this end, we recommend to apply the Grey-DEMATEL approach, which not only helps to define the interactional relationship between each factor, but assists to define the importance of each factor concerning the other ones.

2. BUILD-OPERATE-TRANSFER (BOT)

Build-operate-transfer (BOT) project commonly refers to as public-private partnerships (PPPs) or private participation (PP)—which are collective terms for BOT—, build-operate-own (BOO), build-operate-own-transfer (BOOT), build-transfer-operate (BTO), build-transfer (BT), reconstruction-operate-transfer (ROT), operate-transfer (OT), etc. are contingent on concession agreement (Kumaraswamy and Morris, 2002). Generally, various types of PPPs have been applied in infrastructure development to reach optimum results (Gupta *et al.*, 2013). BOT is long-term co-operation of public and private sectors to gain mutual advantages in which the cooperating sectors concur to share benefits, costs, and risks mutually in the products or services development (Muhammad and Johar, 2019). BOT projects which adopted in wealthy industrialized countries endeavor to finance new infrastructure projects through the participation of the private sector (Senturk *et al.* 2004). Various studies represent that BOT projects which sponsored by the government, encourage the private firms to take part in such public infrastructure projects (Dias and Ioannou, 1995; Liddle, 1997). In the application of BOT procurement system, a private investor, or a group of investors creating a consortium, which provides funds for the construction and operation of infrastructure in the specified period from the government. This private sector mostly refers to as the investor franchise, by which the investor is to “build” and “operate” the project within a pre-set concession period which at the end of that “transfer” the project to the host government without any charge. Since half of the 1980s, this arrangement type of contract has been extensively utilized to infrastructure projects whole the world. The advantage of this

contractual arrangement is generally assumed to be the use of private money for public infrastructure facilities development such as railways, highways, tunnels, ports, airports, hydraulic structures, power plants, and water conservation facilities (Shen *et al.* 1996). This unique approach provides a step forward in supplying the world’s demand for further infrastructure development, particularly in the swiftly developing countries. Meantime, the BOT concept which along with reduced government involvement and an excellent opportunity to obtain profits, opens up chances for market penetration of foreign and also local contractors and developers in the context of infrastructure project construction and operation (Tiong *et al.*, 1992). The private funding in BOT scheme not only diminishes the risks, responsibilities, and financial pressures on the government but also facilitates further innovations by utilizing the technologies, skills, and operational efficiency of the private sector (Gupta *et al.*, 2013). Although the BOT model for the financing of the infrastructure has a rapidly growing for the developing countries and construction industry lacking funds, several difficulties have been faced in global infrastructure development via BOT (for example the slow progress in the BOT implementation). There are other crucial problems such as political, legal, environmental, and social, which have even resulted in BOT projects failures (Gupta *et al.*, 2013).

3. RESEARCH BACKGROUND

In the past few decades, the responsibilities and roles of the owner, architect or engineer, and contractor have been determined clearly. The owner (or client) employs the architect for preparing project design and construction documents. Then, in a tender, the contractor with a reasonable suggested price is selected for construction of a project. The contract for the mentioned project will be signed between the owner and the contractor. Advisory and monitoring roles in the contract will also be signed between the architect or engineer and the owner. Moreover, the right selection of implementation system for projects in the construction industry is critical to achieve success. (Kahvandi *et al.*, 2019). In practical literature, the role of BOT implementation is taken in varied places (for example: Marriott and Brown, 1991; Chu, 1999; Qiao *et al.*, 2001; Askar and Gab-Allah, 2002; Lu *et al.*, 2003; Shams and Awamleh, 2004; Subprasom and Chen, 2005; Algarni *et al.*, 2007; Ilanto, 2008; Chan *et al.*, 2010; Shrestha, 2011; Markom and Ali, 2012; Yong and Mustaffa,

2012; Cheung *et al.*, 2012; Olusola Babatunde *et al.*, 2012; Ismail, 2013; Gupta *et al.*, 2013; Yusof and Salami, 2013; Toulabi, 2013; Emmanuel, 2014). Markom and Ali (2012) found that there are extensive fundamental factors involving to the success of BOT projects comprising: strong government support, firm policy, and regulatory framework, project transparency in formulation and documentation, dependable sponsors and impartial deals for all sections. They concluded that measures to eliminate the problems are clarified to increase the productiveness and efficacy of both BOT proper technique and privatization as a whole. Yong and Mustaffa (2012) indicated that considerable stability in conception between respondents in verifying the importance of human-related factors comprising devotion, capability, collaboration, and communication for a successful construction project. Cheung *et al.* (2012) analysed CSFs of PPPs implementation in Hong Kong and China. They found that both Hong Kong and China have been intense to provide further infrastructure service projects via PPP mode, and furthermore unlike Hong Kong, China perceived multi-benefit objectives significantly and was more interested in an impartial mechanism of risk sharing. Ismail (2013) explored the importance of the success factors in Malaysia and identified the "good governance", "favourable legal framework", "commitment of the public and private sectors", "availability of finance market" and "sound economic policy" as the top five success factors in implementing PPP in Malaysia. Yusof and Salami (2013) investigated the CSFs of BOT power plant projects in Iran, in which identified the appropriate project identification, stable political situation, favourable legislation regulation, and well-organized and committed public agency as the most important factors in BOT pow-

er plant projects in Iran. Toulabi (2013) investigated the potential of BOT implementation in the Iranian environment, in which discovered that there is a need to identify CSFs for BOT projects. Emmanuel (2014) represented that CSFs for prospering PPP implementation is explicit and forceful regulatory framework, universal feasibility study and appropriate risk allocation amongst others, and furthermore some CSFs for instance dedication and responsibility of public and private sectors, stable private society and admissible cost/benefit evaluation amongst others are essential for implementation of PPP.

Despite several previous studies which have investigated the CSFs of BOT projects, studies on CSFs for implementing BOT projects in Iran remain scarce, in which there is no research to identify the critical success factors considering their interrelationships (cause and effect relationships) in an environment of uncertainty and vagueness. Therefore, to cover this research gap, this study identifies and evaluates the critical success factors relevant to Iranian's BOT projects, using a Grey-DEMATEL approach which not only helps to define the interactional relationship between each factor but assists to define the importance of each factor concerning the other ones.

The methods that researchers used in the past to analyse and prioritize CSFs are shown in Table 1 with an overview of applied methods and their limitations against the adopted method in this research. As mentioned in Table 2, the most important advantages of using Grey-DEMATEL approach are considering interrelationships and uncertainty to prioritize CSFs.

Table 1. Methods used for prioritizing CSFs of BOT projects

Researchers	Subject	Methods	Shortcomings	
			Interrelations	Uncertainty
Li and Wang (2019)	Risk assessment of PPP: A China perspective	fuzzy analytic network process (ANP) and ISM	Partially supported	Supported
Ahmadabadi and Heravi (2019)	The effect of CSFs on project success in PPP projects: A case study of highway projects in Iran	PLS- Structural Equation Model (SEM)	Supported	Not supported
Muhammad and Johar (2019)	CSFs of PPP projects: a comparative analysis of the housing sector between Malaysia and Nigeria	Case study approach	Not supported	Not supported
Sarvari <i>et al.</i> (2019)	Approaches to risk identification in PPP projects: Malaysian private partners' overview	Mean score ranking technique	Not supported	Not supported
Babatunde <i>et al.</i> (2019)	Identification of critical risk factors in PPP project phases in developing countries: A case of Nigeria	Descriptive statistics, mean score, Kruskal-Wallis test, risk significance index	Not supported	Not supported
Wang <i>et al.</i> (2019)	The role of governance setting on the association between risk allocation and private investment in PPP markets: developing countries	Regression model	Not supported	Not supported
Kavishe and Chileshe (2018)	CSFs in PPPs on affordable housing schemes delivery in Tanzania	Qualitative (interview), content analysis.	Not supported	Not supported
Kuwaiti <i>et al.</i> (2018)	Determining success factors in Abu Dhabi health care construction projects	Analytical Hierarchy Process (AHP)	Not supported	Not supported
Vijayabalu and Vignesh (2018)	Critical factors determining the success of PPP in construction projects: an Indian Context	Mean, Factor Analysis, Correlation, Regression and ANOVA	Partially supported	Not supported
Yu <i>et al.</i> (2018)	Assessment and grade of risk factors in transnational PPPs projects	fuzzy analytic hierarchy process (FAHP)	Not supported	Supported
Ghanbaripour <i>et al.</i> (2018)	CSFs for subway construction projects – main contractors' perspectives	Correlation coefficients analysis	Partially supported	Not supported
Adnyana <i>et al.</i> (2015)	CSFs of public-private-community partnership in Bali tourism infrastructure development	Exploratory factor analysis	Not supported	Not supported

Sharaffudin and Al-Mutairi (2015)	Success factors for the implementation of BOT projects in Kuwait	Mean score ranking technique	Not supported	Not supported
Wang <i>et al.</i> (2015)	Factors influencing the financial efficiency of PPP projects and their relations	DEMATEL	Supported	Not supported
Gupta <i>et al.</i> (2013)	Identifying and ranking of CSFs for BOT projects in India	Analytical Hierarchy Process (AHP)	Not supported	Not supported

4. IDENTIFYING THE CSFS FOR BOT PROJECTS

The exploration of critical success factors (CSFs) is indispensable to the favourable outcome of business process management (Trkman, 2010). Rockart (1982) defined CSFs as “the key scopes of activity necessary to be focused on making certain competitive performance towards an organization’s strategic objectives.” Kwak *et al.* (2009) described the CSFs as the core aspects where “things must go well for the business to develop.” Boynton and Zmud (1984) defined CSFs as a methodology to focus on identifying the key areas essential to successful management. This methodology has been used extensively in industries such as construction, manufacturing, information systems, and financial services (Rockart, 1982; Boynton and Zmud, 1984; Mohr and Speckman, 1994). CSFs also defined as the essential factors of the project participants for project objectives achievement. (Tiong, 1992; Sanvido *et al.*, 1992; Cooke-Davies, 2002). Furthermore, Rockart (1982) emphasized that CSFs relate to the particular features or circumstances of an industry. It will surely be different in each country, depending on their operating environment, policies, and legal restriction. Also, mostly the CSFs will change with the changes in the industry’s environment, the company’s position within an industry change or a specific problem or opportunity happen for that industry. Therefore, CSFs are not a standard set of key measurements, which can be utilized in all industry. However, CSFs are the specific areas of main significance to a specific industry, at a specific period (Rockart and Bullen, 1981).

Studies and discussions about CSFs for BOT projects have been previously done. Zhang (2005) identified 47 CSFs of public-private partnership projects such as BOT, which have

been categorized into five main dimensions of CSFs namely “economic viability”, “sound financial package”, “appropriate risk allocation via reliable contractual arrangements”, “reliable concessionaire consortium with strong technical strength”, and “favourable investment environment”. Jacobson and Choi (2008) applied qualitative analysis to examine essential factors that taking part in success of PPP projects, in which identified 10 CSFs comprising: “commitment”, “specific plan/vision”, “willingness to compromise/collaborate”, “open communication and trust”, “community outreach”, “respect”, “political support”, “risk awareness”, “expert advice and review”, and “clear roles and responsibilities”. Chan *et al.* (2010) indicated that CSFs for success of project can be classified into five sub-factors comprising: “shared responsibility between public and private sectors”, “stable macroeconomic environment”, “transparent and efficient procurement process”, “judicious government control”, and “stable political and social environment”. Ismail and Ajija (2011) identified top five CSFs for implementing PPP in Malaysia including: “favourable legal framework”, “good governance”, “availability of finance market”, “sound economic policy”, and “commitment of the public and private sectors”.

In the current study, the primary CSFs were collected according to a literature review and sent to 40 Iranian professors and practitioner through a questionnaire to select the most important and relevant CSFs for BOT projects. Finally, 39 factors are identified that grouped into seven main factors according to the literature and previous research. For instance, TC1 (Technical innovation/complexity) regarding other research works mostly related to “Technical Considerations” so as we. The final CSFs and their sub-factors demonstrated in Table 2.

Table 2. Critical success factors of BOT projects

CSFs	Success sub-factors	Resources
Financial Considerations (FC)	FC1: Financing budgeted stable	Adnyana <i>et al.</i> (2015)
	FC2: The investment scheduling payments	Adnyana <i>et al.</i> (2015)
	FC3: Availability of long-term debt financing	Gupta <i>et al.</i> (2013), Zhang (2005)
	FC4: Appropriate toll/tariff level(s) and suitable adjustment formula	Tiong <i>et al.</i> (1992), Qiao <i>et al.</i> (2001), Zhang (2005), Ng <i>et al.</i> (2012)
	FC5: Long-term availability of suppliers needed for the normal operation of the project	Gupta <i>et al.</i> (2013), Zhang (2005)
Risk Allocation (RA)	RA1: Design and construction contract	Gupta <i>et al.</i> (2013), Hwang <i>et al.</i> (2013), Zhang (2005)
	RA2: Concession agreement	Adnyana <i>et al.</i> (2015), Qiao <i>et al.</i> (2001), Tiong <i>et al.</i> (1992)
	RA3: Shareholder agreement	Adnyana <i>et al.</i> (2015), Zhang (2005)
	RA4: The insurance agreement	Adnyana <i>et al.</i> (2015), Zhang (2005)
	RA5: Loan agreement	Adnyana <i>et al.</i> (2015), Gupta <i>et al.</i> (2013), Zhang (2005)
	RA6: Operating expenses agreement	Adnyana <i>et al.</i> (2015), Zhang (2005)
	RA7: Predicable risk scenarios	Adnyana <i>et al.</i> (2015), Zhang (2005)
Concessionaire Consortium (CC)	CC1: Selection procedure of concessionaire	Gupta <i>et al.</i> (2013), Jamali (2004)
	CC2: Strong and capable project team	Gupta <i>et al.</i> (2013), Ng <i>et al.</i> (2012), Zhang (2005), Dixon <i>et al.</i> (2005)
	CC3: Effective and detailed project organization structure	Mladenovic <i>et al.</i> (2013), Abdul-Aziz and Jahn Kassim (2011), Jacobson and Choi (2008), Zhang (2005)
	CC4: Leading role by a key enterprise or entrepreneur	Adnyana <i>et al.</i> (2015), Gupta <i>et al.</i> (2013), Zhang (2005), Tiong <i>et al.</i> (1992)
	CC5: Rich experience in international BOT project management	Sharaffudin and Al-Mutairi (2015), Zhang (2005), Qiao <i>et al.</i> (2001)
Technical Considerations (TC)	TC1: Technical innovation/complexity	Liu and Wilkinson (2013), Dulaimi <i>et al.</i> (2010), Jefferies (2006), Jefferies <i>et al.</i> (2002), Tiong <i>et al.</i> (1992)
	TC2: Project technical feasibility	Li <i>et al.</i> (2005)
	TC3: Advanced and appropriate technology	Adnyana <i>et al.</i> (2015), Gupta <i>et al.</i> (2013)

Technical Considerations (TC)	TC4: Technology transfer	Sharaffudin and Al-Mutairi (2015), Jefferies <i>et al.</i> (2002), Qiao <i>et al.</i> (2001)
	TC5: Availability of providers at the time of long-term operational	Adnyana <i>et al.</i> (2015), Gupta <i>et al.</i> (2013), Zhang (2005)
	TC6: Cost effective	Adnyana <i>et al.</i> (2015), Gupta <i>et al.</i> (2013), Zhang (2005), Tiong <i>et al.</i> (1992)
Government Support (GS)	GS1: Strong commitment and responsibility from the government	Adnyana <i>et al.</i> (2015), Tang <i>et al.</i> (2010), Jacobson and Choi (2008), Li <i>et al.</i> (2005)
	GS2: Special guarantees by the government	Liu and Wilkinson (2013), Ng <i>et al.</i> (2012), Olusola Babatunde <i>et al.</i> (2012), Li <i>et al.</i> (2005), Qiao <i>et al.</i> (2001)
	GS3: Government policy support	Sharaffudin and Al-Mutairi (2015), Gupta <i>et al.</i> (2013), Zhang (2005)
	GS4: Good cooperation of government with the private sector and communities in terms of authority	Adnyana <i>et al.</i> (2015)
	GS5: Fiscal concession and investment policy	Gupta <i>et al.</i> (2013)
	PE1: Public/community awareness and support	Gupta <i>et al.</i> (2013), Zhang (2005)
Prevailing Environment (PE)	PE2: Public safety and health considerations	Sharaffudin and Al-Mutairi (2015), Zhang (2005), Qiao <i>et al.</i> (2001)
	PE3: Predictable and reasonable legal framework	Mladenovic <i>et al.</i> (2013), Hwang <i>et al.</i> (2013), Olusola Babatunde <i>et al.</i> (2012), Li <i>et al.</i> (2005), Zhang (2005), Jamali (2004)
	PE4: Stable and favourable economic environment	Adnyana <i>et al.</i> (2015), Mladenovic <i>et al.</i> (2013), Liu and Wilkinson (2013), Olusola Babatunde <i>et al.</i> (2012), Zhang (2005), Qiao <i>et al.</i> (2001)
	PE5: Stable government	Gupta <i>et al.</i> (2013)
	PE6: Stable political system	Sharaffudin and Al-Mutairi (2015), Mladenovic <i>et al.</i> (2013), Jefferies (2006), Zhang (2005), Qiao <i>et al.</i> (2001)
	SC1: Activities that do not conflict with religious, social communities and national law	Adnyana <i>et al.</i> (2015)
Social and Culture (SC)	SC2: Utilize local company in the project company	Sharaffudin and Al-Mutairi (2015), Tiong <i>et al.</i> (1992)
	SC3: Giving priority to local employment during the construction and operational	Adnyana <i>et al.</i> (2015)
	SC4: Giving priority to local raw materials	Adnyana <i>et al.</i> (2015)
	SC5: Training local staff	Sharaffudin and Al-Mutairi (2015), Qiao <i>et al.</i> (2001)

A BOT project includes various procedures which are affected by many internal/external factors. The CSFs in this research may not be the precise criteria for every project, but they were derived through the research process of extensive literature review and interviews with local professionals involved in BOT projects. These CSFs were validated using survey research and case studies. The CSFs cover a full range of key aspects of BOT projects and provide a set of factors that assists in proposing a framework for evaluating and analysing CSFs of Iranian's BOT projects.

5. RESEARCH METHOD

5.1 Grey system theory

Grey systems theory aims at covering the data and series production for the real patterns modelling that is based on

poor (negligible) information (Liu and Lin, 2006). The grey theory introduced by Deng (1982) from a grey set. In grey systems, the word "grey" is applied when the information is partly known and partly unknown. In other words, being "grey" refers to having "incomplete information" (Mierzwia et al., 2018). Grey systems theory can handle many of the ambiguities generated from vague human decisions (Fu et al., 2001; Li et al., 2007). Grey theory is useful to solve the multi-criteria decision making (MCDM) problems in an uncertainty and vagueness environment, and further has been applied to various areas such as decision-making, forecasting, system control, computer graphics, etc. (Li et al., 2007). The grey value is the number of uncertain data (Dong et al., 2006).

Let X as a universal set, \mathcal{G} as Grey set of universal set X , $\overline{\mu}_{\mathcal{G}}(x)$ and $\underline{\mu}_{\mathcal{G}}(x)$ defines as the upper and lowest boundary of the \mathcal{G} membership function as in equation (1):

$$\underline{\mu}_{\mathcal{G}}(x) : X \rightarrow [0,1] \quad , \quad \overline{\mu}_{\mathcal{G}}(x) : X \rightarrow [0,1] \quad (1)$$

The equation $\overline{\mu}_{\mathcal{G}}(x) \geq \underline{\mu}_{\mathcal{G}}(x)$ is completely understandable and changes into a fuzzy set in the form of an equation of the grey set. This shows that the grey theory includes fuzzy and flexible cases when facing fuzzy problems (Nezhad et al., 2009). In this study, the grey number $\otimes X_{ij}^p$ for P decision is considered to assess the effect of j /criterion on j (Asad et al., 2016a, 2016b):

$$\otimes X_{ij}^p = [\underline{\otimes} X_{ij}^p, \overline{\otimes} X_{ij}^p] \quad (2)$$

The grey data turns into a crisp number as following three steps:

1: Normalization:

$$\Delta_{Min}^{Max} = Max_j \overline{\otimes} X_{ij}^p - Min_j \underline{\otimes} X_{ij}^p \quad (3)$$

$$\underline{\otimes} \tilde{X}_{ij}^p = (\underline{\otimes} X_{ij}^p - Min_j \underline{\otimes} X_{ij}^p) / \Delta_{Min}^{Max} \quad (4)$$

$$\overline{\otimes} \tilde{X}_{ij}^p = (\overline{\otimes} X_{ij}^p - Min_j \underline{\otimes} X_{ij}^p) / \Delta_{Min}^{Max} \quad (5)$$

2: Calculate total normalized crisp number:

$$Y_{ij}^p = \frac{(\underline{\otimes} X_{ij}^p(1 - \underline{\otimes} X_{ij}^p) + (\overline{\otimes} X_{ij}^p \times \underline{\otimes} X_{ij}^p)}{1 - \underline{\otimes} X_{ij}^p + \overline{\otimes} X_{ij}^p} \quad (6)$$

3: Calculate the crisp number:

$$Z_{ij}^p = Min_j \underline{\otimes} X_{ij}^p + Y_{ij}^p \Delta_{Min}^{Max} \quad (7)$$

From equation (8) is used to turn opinions into a unit viewpoint:

$$Z_{ij}^p = \frac{1}{p} (Z_{ij}^1 + Z_{ij}^2 + \dots + Z_{ij}^p) \quad (8)$$

5.2 DEMATEL method

Decision-making trial and evaluation laboratory (DEMATEL) approach in the first place developed by the Battelle Memorial Institute of Geneva. It could structure and handle complicated interrelationship among the criteria using a combination of matrices or graphs, and also intended to resolve the complicated problem by understanding the particular problem, the cluster of intertwined problem, and recognition of practicable solutions through a hierarchical structure (Jeng and Tzeng, 2012; Wu, 2012; Hsu *et al.*, 2013). DEMATEL approach based on assumptions of a system that com-

teria which means effectiveness of variables; (D) for each criterion indicates the impact of other criteria on it which means influence of variables; the “Influence” horizontal axis vector (R+D) represents the degree of importance, and the “Relation” vertical axis (R-D) classified criteria into a cause group and an effect group. (R-D) positive value indicates that the criterion puts in the cause group, and negative value shows that the criterion belongs to the effect group (Hung, 2011).

In this approach, firstly, according to the experts' viewpoints and the critical factors, a direct relation matrix organized. The consequential T-matrix is an $n \times n$ matrix which represents interactions criteria, as T_{ij} denotes to the degree of effect of i -factor on j -factor, $T = [T_{ij}]_{n \times n}$ (Asad *et al.*, 2016a, 2016b).

In the next step, we create the normalized matrix of direct relation (S), $S = [S_{ij}]_{n \times n}$, where $0 \leq S \leq 1$. Instructions of making the matrix S are according to equations (9) and (10) as follows (Asad *et al.*, 2016a, 2016b):

$$K = \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}} \quad (9)$$

$$S = K \times T \quad (10)$$

Then, the total relation matrix (T) made by equation (11), where / represent an $n \times n$ identity matrix:

$$M = S(I - S)^{-1} \quad (11)$$

R and D indicate to the sum of rows and columns calculated form the equations (12), (13) and (14) as follows:

$$M = m_{ij}, (i,j=1, 2, \dots, n) \quad (12)$$

$$R = [\sum_{j=1}^n m_{ij}]_{n \times 1} \quad (13)$$

$$D = [\sum_{j=1}^n m_{ij}]_{1 \times n} \quad (14)$$

prised a variable set and paired comparisons and the relationship amongst these variables is made via mathematical models (Büyüközkan and Çifçi, 2012). Compared with other multi-attribute decision-making approaches such as Analytical Hierarchical Process (AHP), in which criteria are assumed independent; DEMATEL method is a structural modelling approach that aims at discovering the interdependence amongst the elements of a system by a causal diagram (Tseng, 2009; Wu *et al.*, 2010).

Finally, to determine the interrelationships (cause and effect), (R) reflects effectiveness of a criterion on other cri-

5.3 Reliability and Consistency

The validity of the instrument used in this research is in some way, a kind of rational validity or content that is related to the applied method. In the paired comparison method, all factors are measured together, which eliminates all the probabilities associated with not considering a criterion or a question. The structure and criteria used in this study were also decided upon by the team members. Moreover, the ability of the tool to maintain its reliability over time, despite the controllable condition of the test and the status of the respondents, suggests its stability and least variability.

However, according to the type of questionnaire, it should be noted that in this type of questionnaire, all criteria and factors are measured in a two-way manner. In other words, the maximum possible questions are asked with the desired structure of the respondent, so there is no need to measure reliability since all the criteria are considered and the designer is not capable of specific orientation in the design of the questions.

Contrasting AHP technique using the consistency ratio (CR) to test for the consistency of the decision makers' judgment, the DEMATEL approach has not the CR assessment to confirm if the comparisons presented by decision makers are consistent (Lee *et al.*, 2018). Shieh and Wu (2016) suggested a combined method of using corrected item-total correlation and split-half approaches to assess the consistency of the study data. Nevertheless, their research result is to find those experts who have different views than others. Those experts with different views might have unparalleled views to be considered, or their unreliable views should be eliminated. There is no transparent process to decide if each decision maker's view is valid hitherto for the DEMATEL approach. For example, the available research papers of Professor G.H Tzeng, a specialist in DEMATEL approach development and utilization, suppose the decision makers' views are valid with no more checking the reliability of the research results (Liou *et al.*, 2008; Lu *et al.*, 2013; Chang *et al.*, 2015).

6. RESEARCH FINDINGS AND DISCUSSION

In this present study, according to the literature and research background the critical success factors of Iranian's BOT projects collected, then the opinion of local experts and practitioners asked through a questionnaire, and finally, 39 factors were identified that grouped into seven main factors. Next, to evaluate the interrelationships of factors an online questionnaire was designed with one-by-one questions, in which asked from local experts and practitioners to how each factor affect to the other ones using linguistic variables (no effect, very low effect, low effect, high effect, very high effect). Finally, 40 completed questionnaires collected to analyse interrelationships among the CSFs, using Grey-DEMATEL approach. Also, the demographic statistics of respondents are shown in Table 3.

According to Table 3 statistics, the respondents have adequate experience and knowledge in BOT projects in Iran. Therefore, the information provided on BOT projects by these respondents' organizations is declared to be reliable.

Next, after gathering all the completed questionnaires, the responses from linguistic variable turned into grey value ranges (Table 4), then according to equations (3) to (7), grey numbers are transformed to crisp numbers, and all views are unified into a single opinion by equation (8).

Table 3. Demographic statistics of respondents

Gender		Age (year)				Education			Experience (year)					
Male	Female	Under 30	30-40	40-50	Over 50	BA	MA	PhD	1-5	5-10	10-15	15-20	Over 20	
28	12	4	7	11	18	7	19	14	2	5	8	10	15	
Number of BOT project executed						Organization category								
1	2	3	4	5	Over 5	Public sector authorities			Concessionaire		Lender/bank			
2	1	5	6	11	15	17			13		10			

Table 4. Linguistic scales of importance weight of factors and their Grey values

Linguistic variable	Grey values
No affect	[0,0]
Very low affect	[0,0.25]
Low affect	[0.25,0.5]
High affect	[0.5,0.75]
Very high affect	[0.75,1.0]

In the next step, the crisp numbers normalized in DEMATEL using the equations (9) and (10), and total matrix of each of the main factors and their sub-factors are calculated using equation (11). In the end, the values of R, D, R+D, and R-D are calculated in, which the results are shown in Table 5.

Table 5. Results of Grey-DEMATEL analysis for CSFs of BOT projects in Iran

Factors	R	Rank	D	Rank	R+D	Rank	R-D
Financial Considerations (FC)	3.261739342	2	3.67003514	1	6.931774482	1	-0.408295798
Risk Allocation (RA)	2.806410014	4	3.557400431	2	6.363810445	2	-0.750990416
Concessionaire Consortium (CC)	3.720839685	1	2.280212793	6	6.001052477	3	1.440626892
Technical Considerations (TC)	2.534356876	5	3.092577492	4	5.626934367	4	-0.558220616
Government Support (GS)	2.220551387	7	3.314613572	3	5.535164958	5	-1.094062185
Prevailing Environment (PE)	3.198453314	3	2.300206648	5	5.498659962	6	0.898246666
Social and Culture (SC)	2.476640466	6	2.003945009	7	4.480585474	7	0.472695457
FC	FC1	2.304529462	2	1.298602238	5	3.6031317	3
	FC2	1.619993497	3	2.294380488	1	3.914373985	2
	FC3	1.369228177	4	1.576370983	4	2.94559916	5
	FC4	1.359601583	5	2.007145635	3	3.366747218	4
	FC5	2.640230561	1	2.117083936	2	4.757314496	1
RA	RA1	3.03351486	1	1.666519639	7	4.700034499	2
	RA2	1.457735694	7	2.094664307	4	3.552400001	7
	RA3	1.877117175	6	2.249725412	3	4.126842588	4
	RA4	1.983575912	4	1.671581571	6	3.655157483	6
	RA5	1.961809961	5	1.992404024	5	3.954213985	5
	RA6	2.001347733	3	2.624196968	2	4.6255447	3
	RA7	2.784787839	2	2.800797254	1	5.585585093	1
CC	CC1	3.34464497	1	2.033459095	5	5.378104065	2
	CC2	2.118601027	3	3.023195402	1	5.14179643	3

	CC3	1.989109037	5	2.310878064	4	4.299987101	5	-0.321769028
CC	CC4	2.054762095	4	2.752160758	2	4.806922853	4	-0.697398663
	CC5	3.153273922	2	2.540697731	3	5.693971652	1	0.612576191
	TC1	1.891035302	6	2.138053065	6	4.029088366	6	-0.247017763
TC	TC2	2.245547733	4	2.693215619	2	4.938763352	3	-0.447667886
	TC3	3.332666578	1	2.183168195	5	5.515834773	2	1.149498383
	TC4	2.616693174	3	2.29492986	4	4.911623034	4	0.321763314
	TC5	2.224660155	5	2.47444684	3	4.699106994	5	-0.249786685
	TC6	3.185217634	2	3.712006997	1	6.897224631	1	-0.526789363
	GS1	2.650186609	1	1.619555824	4	4.269742433	1	1.030630785
GS	GS2	1.834908338	2	1.889630498	3	3.724538836	3	-0.05472216
	GS3	1.676511538	4	1.38866113	5	3.065172668	5	0.287850408
	GS4	1.428905505	5	1.967613043	2	3.396518548	4	-0.538707537
	GS5	1.678511303	3	2.403562798	1	4.082074101	2	-0.725051496
PE	PE1	1.908316315	5	0.218306158	6	2.126622473	6	1.690010156
	PE2	2.328046826	3	0.693559185	5	3.02160601	5	1.634487641
	PE3	1.92329745	4	1.851830331	4	3.775127781	4	0.071467118
	PE4	2.583715365	2	3.019994677	3	5.603710041	3	-0.436279312
	PE5	1.840539003	6	3.964920105	1	5.805459108	2	-2.124381102
	PE6	3.052280494	1	3.887584996	2	6.939865491	1	-0.835304502
SC	SC1	2.768771282	3	2.724072798	3	5.49284408	3	0.044698484
	SC2	0.933206305	5	2.001630774	5	2.934837079	5	-1.068424469
	SC3	2.432848344	4	2.883260032	2	5.316108376	4	-0.450411688
	SC4	3.276695362	2	2.240669006	4	5.517364368	2	1.036026356
	SC5	3.33292441	1	2.894813092	1	6.227737502	1	0.438111317

According to Table 5, the results for the seven main CSFs shows the factor "Concessionaire Consortium (CC)" according to R criterion, has the most considerable influence on other main factors; also, according to D criterion, the factor "Financial Considerations (FC)" most affected from other main factors; it also according to R+D, has the most interaction with the other main factors, which demonstrates great importance of this factor in BOT projects. Furthermore, according to the R-D measure, it was discovered that the main factors "Concessionaire Consortium (CC)", "Prevailing Environment (PE)" and "Social and Culture (SC)" are the causal factors (positive value), and the main factors "Financial Considerations (FC)", "Risk Allocation (RA)", and "Technical Considerations (TC)" are the effect factors (negative value).

These findings show that "Financial Considerations" has the most priority and needs more attention from Iranian project managers (PMs). It also discovered that "Concessionaire Consortium" is the most dominant factor among the other ones and should be noticed by PMs.

In sum, the results show that seven main CSFs and their sub-factors prioritized by their interactions (R+D) as below:

1. Financial Considerations (6.93) – *Effect*
 - I. Long-term availability of suppliers needed for the normal operation of the project (4.76) – *Cause*
 - II. The investment scheduling payments (3.91) – *Effect*
 - III. Financing budgeted stable (3.60) – *Cause*

- IV. Appropriate toll/tariff level(s) and suitable adjustment formula (3.37) – *Effect*
- V. Availability of long-term debt financing (2.94) – *Effect*
- 2. Risk Allocation (6.36) – *Effect*
 - I. Predictable risk scenarios (5.58) – *Effect*
 - II. Design and construction contract (4.70) – *Cause*
 - III. Operating expenses agreement (4.62) – *Effect*
 - IV. Shareholder agreement (4.13) – *Effect*
 - V. Loan agreement (3.95) – *Effect*
 - VI. The insurance agreement (3.65) – *Cause*
 - VII. Concession agreement (3.55) – *Effect*
- 3. Concessionaire Consortium (6.00) – *Cause*
 - I. Rich experience in international BOT project management (5.69) – *Cause*
 - II. Selection procedure of concessionaire (5.38) – *Cause*
 - III. Strong and capable project team (5.14) – *Effect*
 - IV. Leading role by a key enterprise or entrepreneur (4.81) – *Effect*
 - V. Effective and detailed project organization structure (4.30) – *Effect*
- 4. Technical Considerations (5.63)- *Effect*
 - I. Cost Effective (6.90) – *Effect*
 - II. Advanced and appropriate technology (5.51) – *Cause*
 - III. Project technical feasibility (4.94) – *Effect*
 - IV. Technology transfer (4.91) – *Cause*
 - V. Availability of providers at the time of long-term operational (4.70) – *Effect*
 - VI. Technical innovation/complexity (4.03) – *Effect*
- 5. Government Support (5.54)- *Effect*
 - I. Strong commitment and responsibility from the government (4.27) – *Cause*
 - II. Fiscal concession and investment policy (4.08) – *Effect*
 - III. Special guarantees by the government (3.72) – *Effect*
 - IV. Good cooperation of government with the private sector and communities in terms of authority (3.40) – *Effect*
 - V. 5.Government policy support (3.06) – *Cause*
- 6. Prevailing Environment (5.50) – *Cause*
 - I. Stable political system (6.94) – *Effect*
 - II. Stable government (5.80) – *Effect*
 - III. Stable and favourable economic environment (5.60) – *Effect*
- IV. Predictable and reasonable legal framework (3.77) – *Cause*
- V. Public safety and health considerations (3.02) – *Cause*
- VI. Public/community awareness and support (2.13) – *Cause*
- 7. Social and Culture (4.48) – *Cause*
 - I. Training local staff (6.23) – *Cause*
 - II. Giving priority to local raw materials (5.52) – *Cause*
 - III. Activities that do not conflict with religious, social communities and national law (5.49) – *Cause*
 - IV. Giving priority to local employment during the construction and operational (5.32) – *Effect*
 - V. Utilize local company in the project company (2.93) – *Effect*

7. CONCLUSION

In the current study, the DEMATEL approach applied to analyse interrelationships of the critical success factors for Iranian's BOT projects, in which considering the entrance data as a range of uncertain numbers (Grey numbers), is the special characteristic of merging Grey theory to this method. In other words, the utilization of Grey theory system makes it possible to consider the uncertainty of the decision system structure. Furthermore, the application of decision-making trial and evaluation laboratory (DEMATEL) approach assists the decision maker to recognize causal factor(s) and sub-factor(s) within each other and figure out the relative cause-effect relationships between factors and sub-factors.

Regarding the DEMATEL analysis outputs (R, D, R+D, and R-D), we can say that the revealed results could be divided into four parts namely "effectiveness or dominance", "influence or impressionability", "superiority", and "cause/effect" measures.

According to the measure "effectiveness or dominance", factors with the most dominant characteristic in each group are: "Long-term availability of suppliers needed for the normal operation of the project", "Design and construction contract", "Selection procedure of concessionaire", "Advanced and appropriate technology", "Strong commitment and responsibility from the government", "Stable political system", and "Training local staff". These criteria have a leading role in their group and affect other factors signifi-

cantly, so they need to be well-thought-out by Iranian project managers (PMs) in BOT project management.

Given to the measure "influence or impressionability", factors with the most impressionability characteristic in each group are: "The investment scheduling payments", "Predictable risk scenarios", "Strong and capable project team", "Cost-effective", "Fiscal concession and investment policy", "Stable government", and "Training local staff". These factors have a sensitive attribute and are most affected by other criteria in their group; then they require be carefully considering and planning by Iranian PMs in the BOT project management.

Moreover, with respect to the most crucial measure "superiority", the criteria with the supremacy attribute in each group are: "Long-term availability of suppliers needed for the normal operation of the project", "Predictable risk scenarios", "Rich experience in international BOT project management", "Cost-effective", "Strong commitment and responsibility from the government", "Stable political system", "Stable government", and "Training local staff". These factors have a superiority attribute which leads to being the most interactional with other criteria in their group; hence, they necessitate being very well-thought-of within the BOT project management by Iranian PMs.

Finally, according to the classification of factors into "cause" and "effect" groups, the most essential cause factors in each main group are: "Financing budgeted stable", "Design and construction contract", "Selection procedure of concessionaire", "Advanced and appropriate technology", "Strong commitment and responsibility from the government", "Public/community awareness and support", and "Giving priority to local raw materials". These factors have a causal relationship with the other criteria in their group and could be attained to assist the managers/decision-makers to have an enhanced understanding of the complicated problems. Nevertheless, some causes such

as "Public/community awareness and support" and "Public safety and health considerations" are less important than the effect factors including "Stable government" and "Stable political system" that are crucial factors to be considered, they are also required to be paid more attention, since they are the roots of the problems and have a considerable impact on the effect factors.

Also, from the seven main factors point of view, the most dominant factor is "Concessionaire Consortium" which shows that it has a leading role among the main criteria and affects other factors meaningfully; therefore, it needs to be well-thought-out by Iranian project managers and decision-makers in the BOT project management. In addition, the factor with the most impressionability and simultaneously with the most priority is "Financial Considerations" which indicates that while it has sensitivity and most affected from other criteria among the main criteria, has a superiority attribute which leads to be the most interactional with other criteria among the main criteria, thus it needs to be cautiously measured and planned by Iranian PMs and decision-makers in the BOT project management. Moreover, the cause factors in the main group are "Concessionaire Consortium", "Prevailing Environment", and "Social and Culture", while the effect factors are "Financial Considerations", "Risk Allocation", "Technical Considerations", and "Government Support", which all could be attained to assist the managers/decision-makers to improve their comprehension of the complicated problems.

As the last word, this study provides another point of view to implement BOT projects without assuming factors and sub-factors are mutually independent. Each action taken on net causes (factor/sub-factor) will have direct/indirect effects on the corresponding net receivers (factor/sub-factor). Therefore, the decision maker can give more credit and allocate resources to cause factors and sub-factors to implement BOT projects in Iran effectively.

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A Cause and Effect Analysis on Critical Risk Factors of Iranian BOT Projects Using a Grey-DEMATEL Method

ABSTRACT

The main idea of this study is to analyse the cause and effect relationships of the critical risk factors (CRFs) of implementing Build, Operate, and Transfer (BOT) projects in Iran using a Grey-DEMATEL method. In so doing, the primary risk factors extracted from the literature were sent to experts and practitioners through a questionnaire in order to be able to select the most essential and relevant critical risk factors of the Iranian BOT projects. Later, 27 critical risk factors were identified and grouped into six main risk factors. Furthermore, a questionnaire was given to some 20 Iranian professors and experts in the field to analyse the cause and effect roles of the identified factors. In order to analyse the cause and effect relationships of the factors in each group, initially, the experts' opinions (under uncertainty) were represented in the form of Grey numbers and then unified into a single opinion. Subsequently, the cause and effect roles of the critical risk factors were analysed through a DEMATEL method. The results indicate effectiveness, influence, interaction, and cause or effect role of the critical risk factors in the Iranian BOT projects.

Keywords: BOT Projects; Cause and Effect Analysis; Critical Risk Factors (CRFs); Grey DEMATEL; Project Risks

1. INTRODUCTION

Over the last two decades, the Build, Operate, and Transfer (BOT) projects have been considered as a major trend to privatize the public sector infrastructure projects (Wang *et al.*, 2019). The private sector utilizes BOT to complete a particular project by receiving a granted concession inde-

pendently. However, when the project is fully completed, its ownership must return to the public sector (Sarvari *et al.*, 2019). Within the BOT procedures (planning, construction, operation, and transfer), the private sectors and the host utility encounter many uncertain factors pertinent to the BOT projects (Kang and Feng, 2009). Many of these difficulties can be prevented through the recognition and analysis of the critical risk factors of the BOT projects. Hitherto, the issue mentioned above has not received enough attention in developing countries (Tadayon *et al.*, 2012). Risk can be defined as a cumulative effect of the opportunities for uncertain incidences, which negatively affect project goals. That is to say: the risk is the degree of exposure to adverse occurrences and their eventual consequences (Askari and Shokrizadeh, 2014). In the process of signing a successful BOT contract, the rivalry is so intense, the financial risk is too high, the negotiations are lengthy, and the opportunity costs are so remarkable (Huang and Dzeng, 2019). Hence, BOT contracts must cover computed risks, attitude flexibility, and compatible proposals under uncertainty. Besides, both public and private sector must take into account these concerns in BOT proposals (Tiong *et al.*, 1992). In this context, Kang and Feng (2009) identify and assess the potential risks with which the private sectors encounter in BOT projects via a developed risk assessment model. Ameyaw and Chan (2015) investigate the risk factors and evaluate the risk level of PPP water supply projects in developing countries using a fuzzy synthetic evaluation (FSE) method. Xu *et al.* (2015) identify the critical risk factors that have an impact on the construction and operation of China's PPP waste-to-energy projects. Hosseini *et al.* (2016) study the viewpoints of construction experts focusing the critical success factors (CSFs) for the employment of risk management systems in developing countries.

Nevertheless, the pertinent issues regarding the BOT project risks are still untouched. Needless to say that identifying such risk factors is of crucial importance to fulfil BOT projects efficiently, especially in developing countries such as Iran. Surprisingly, a tiny amount of research has been done to investigate the critical risk factors of BOT projects in Iran, taking into account their cause and effect relationships. Therefore, in order to fill the research gap, the present study endeavours to identify and analyse the critical risk factors pertinent to BOT projects in Iran. To achieve this objective, we suggest using a Grey-DEMATEL method which not only does assist the definition of the cause and effect relationships between all risk factors, but it also helps determine the relative importance of risk factors compared with the other relevant factors in each group.

2. LITERATURE REVIEW

2.1 BOT project

Build, Operate, and Transfer (BOT) projects are carried out through a governmental grant, in which a concession company finances, constructs, maintains, and operates an infrastructure project. Later, when the specified concession period is over, the ownership of the project returns to the government (Tiong, 1995). BOT is long-term cooperation of public and private sectors to gain mutual advantages in which the cooperating sectors concur to share benefits, costs, and risks mutually in the products or services development (Muhammad and Johar, 2019). The public sector is a particular funder of the projects involved and is conventionally responsible for infrastructure development within its authority (Zhang *et al.* 2016). A large amount of private participation is required in BOT projects, which are beneficial to both the public and private sectors in the current conditions compared to traditional joint business ventures. In other words, both sectors get the benefits of sharing the risks from each other (Askari and Shokrizadeh, 2014). The BOT model, therefore, presents a chance for utilizing the innovative technologies, management proficiencies and operational efficiencies engrossed by private businesses, meanwhile providing an effective manner to make use of private funds in providing public infrastructure (Zhang *et al.*, 2016). This specific approach presents an improvement in supplying the global demands for more significant development of infrastructure, especially in the rapidly developing countries.

Moreover, besides less participation of government and higher profits, the BOT concept opens up opportunities for both foreign and local contractors and developers for construction and operation periods of the infrastructure projects to enter the market (Tiong *et al.*, 1992). BOT projects, which are conditioned by a concession agreement, are also commonly known as PPP: public-private partnership or PP: private participation, which are collective terms for BOT, BOO: build-operate-own, BOOT: build-operate-own-transfer, BTO: build-transfer-operate, BT: build-transfer, ROT: reconstruction-operate-transfer, and OT: operate-transfer (Kumaraswamy and Morris, 2002). In general, several kinds of PPPs have been utilized in infrastructure development to get optimum outcomes (Gupta *et al.*, 2013).

2.2 Research background

In the past few decades, the responsibilities and roles of the owner, architect or engineer, and contractor have been determined clearly. The owner (or client) employs the architect for preparing project design and construction documents. Then, in a tender, the contractor with a reasonable suggested price is selected for construction of a project. The contract for the mentioned project will be signed between the owner and the contractor. Advisory and monitoring roles in the contract will also be signed between the architect or engineer and the owner. Moreover, the right selection of implementation system for projects in the construction industry is critical to achieve success. (Kahvandi *et al.*, 2019). In empirical research, the role of risk factors of BOT/PPP projects was taken into account in various places. Kang and Feng (2009) identified and assessed the potential risks for private sectors in holding BOT projects via a developed model for risk assessment. The results of the numerical example show that the concession period of a BOT project and the foreign exchange ratio are primary and secondary risk factors, respectively. Ke *et al.* (2010) recognized 37 risk factors of PPP projects in China; the results reveal that the public and private sector would mainly be responsible for 13 and ten factors respectively; furthermore, 14 risks with which the public or private sector may not be able to deal are shared evenly. Mojtabaei *et al.* (2010) applied a multi-attribute group decision-making method to identify and assess project risks. They identified 31 potential risks and categorized them into five groups, namely, Management, Construction, Procurement, Engineering, and Commissioning. Xu *et al.* (2010) used a fuzzy synthetic evaluation approach to develop a risk

assessment model for PPP projects in China. They identified 17 critical risk factors which were analysed through factor analysis and later formulated six critical risk groups: Construction and Operation Risk, Macroeconomic Risk, Market Environment Risk, Government Intervention, Economic Viability Risk, and Government Maturity Risk. Their empirical research findings show that the whole risk level of highway PPP projects is between "medium risk" and "high risk". Chou *et al.* (2012) compared the use of PPP policy between high-speed rail (HSR) projects and general infrastructure projects by identifying key factors and risk allocation for PPP policy. They identified 15 critical drivers of PPP, 18 CSFs for PPP, and 37 risk factors in PPP projects. Song *et al.* (2013) investigated the critical risks of PPP waste-to-energy (WTE) incineration projects in China. Ten critical risks were identified from the six projects, including government credit risk, government decision-making risk, public opposition risk, legal and policy risk, environment risk, technical risk, MSW supply risk, contract change risk, revenue risk, and payment risk. Askari and Shokrizadeh (2014) suggested an integrated method for ranking risks in BOT projects. In line with the aims of the research, they ranked the risks of the BOT projects by FTOPSIS and FSAW methods concerning their severity and their effect on "time, cost, quality, safety, and environment". Valipour *et al.* (2015) utilized a fuzzy ANP method for risk prioritization in freeway PPP projects in an Iranian case study, identifying 27 vital impending risks and classifying them into seven groups, namely Financial, Organization and coordination, Operation, Political, Legal, Market, and Force majeure. Their results revealed that legal, financial, and political risks are the most important groups, whereas improper design, granted lands value changes and the termination of the concession are the most significant risks. Ameyaw and Chan (2015), using a fuzzy synthetic evaluation (FSE) approach, investigated the risk factors, and assessed the risk level of water supply PPP projects in developing countries. They eventually identified 22 critical risk factors and grouped them into three major factors, which according to their final results were ranked as follows: financial/commercial, legal and socio-political, and technical category. Xu *et al.* (2015) identified five critical risk factors that affect the construction and operation of PPP waste-to-energy projects in China, namely the deficiency of the supporting infrastructure, the inadequacy of the waste supply, risk of the payment, environmental risk, and access of non-licensed waste. They finally present a detailed study of the contract arrangement, risk sharing plan; risk responds measures to

critical risks and PPP project transfer. Hosseini *et al.* (2016) investigated the perceptions of construction practitioners concerning the critical success factors related to risk management system implementation in developing countries. Their results indicated that four factors were considered as very important: managers' support, coverage of risk management in construction training courses, efforts for systematically delivering the projects, and awareness of the risk management put into action process. Sarvari *et al.* (2019) examined the procedure of risk identification of the private sector in Malaysian PPP projects. Their results suggested that because of knowledge and experience insufficiency of Malaysian private sector in the risk identification procedure, a general database for risk identification was extremely required for the private sector. Babatunde *et al.* (2019) identified and evaluated the risk factors of PPP infrastructure project implementation in Nigeria. They identified 70 risk factors and recognized that 51 of them are moderate risks, and 19 of them are critical risks.

Despite a few numbers of previous studies investigating the risks of BOT projects, studies on the risk factors of implementing the Iranian BOT projects remain scarce, with almost no research identifying the critical risk factors (CRFs) regarding their cause and effect relationships in an environment of uncertainty and vagueness. Thus, in order to fill this research gap, the present study identifies and evaluates the CRFs concerning the Iranian BOT projects, using a Grey-DEMATEL method, which not only does assist in defining the cause and effect relationship between all risk factors, but it also helps determine the relative importance of risk factors compared with the other relevant factors in each group.

2.3 Identifying the CRFs of the BOT Projects

Risk is traditionally defined as the probability that may be different from the real variables and outcomes which were measured initially leading to positive/negative effects (Elzamly and Hussin, 2006). Risk of failure is defined as the probability of suffering because of damage, detriment, or exposure in the project's life cycle (Dhlamini *et al.*, 2009). Risk is incomplete knowledge where any action causes a series of possible results, each with an unknown probability (Varanasi, 2015). It can also be explained as an uncertain occurrence or condition that once it happens; it has a positive/negative impact on the objective of a project (Sathish-kumar *et al.*, 2015).

Cheung and Chan (2011) underline that PPP projects need attentive identification and analysis of risk factors that could negatively affect their success. Furthermore, Hwang *et al.* (2013) reveal that difficulties in controlling and analysis accompany the majority of PPP risks. Hence, the government and private sector must identify, evaluate, allot, and respond to all potential risks satisfactorily all over the entire life cycle of the project (Chan *et al.*, 2010).

Many general PPP risk factors have already been identified, some of which were reviewed in the previous section. Having reviewed the related literature, the current study identifies

approximately 150 items concerning the primary risk factors related to BOT/PPP projects from 20 related research papers published and reviewed in most reliable journals. After excluding repetitive and non-general factors, listed 58 remained risk factors. Then, to select the most significant and pertinent risk factors appropriate for the Iranian BOT projects, a questionnaire was then designed and sent to some Iranian practitioners and experts. Finally, according to experts' opinions, 27 critical risk factors were selected and classified into six main factors based on prior studies which attempted to classify risk factors. Table 1 shows the final critical risk factors and their sub-factors in this study.

Table 1. The critical risk factors of Iranian's BOT projects

Main risk factors	Sub-risk factors	References
Political Risks (PR)	PR1: Sanctions	Valipour <i>et al.</i> (2015)
	PR2: Expropriation and nationalization	Ng and Loosemore (2007), Bing <i>et al.</i> (2005), Wang and Tiong (2000), Ke <i>et al.</i> (2010), Kumaraswamy and Zhang (2001), Medda (2007)
	PR3: Political/Public opposition	Bing <i>et al.</i> (2005), Grimsey and Lewis (2002), Zou <i>et al.</i> (2008)
	PR4: Legislation change	Ng and Loosemore (2007), Lam <i>et al.</i> (2007), Bing <i>et al.</i> (2005), Arndt (1998), Wang and Tiong (2000), Gallimore <i>et al.</i> (1997), Kumaraswamy and Zhang (2001), Grimsey and Lewis (2002), Shen <i>et al.</i> (2006), Maslyukivska and Sohail (2007)
Financial Risks (FR)	PR5: Termination of concession by Government	Ng and Loosemore (2007), Ke <i>et al.</i> (2010), Wang and Tiong (2000),
	FR1: Limited capital	Valipour <i>et al.</i> (2015)
	FR2: Interest rate fluctuation	Ng and Loosemore (2007), Bing <i>et al.</i> (2005), Wang and Tiong (2000), Kumaraswamy and Zhang (2001), Medda (2007), Zou <i>et al.</i> (2008), Xu <i>et al.</i> (2010)
	FR3: Foreign currency exchange	Wang and Tiong (2000), Kumaraswamy and Zhang (2001), Grimsey and Lewis (2002), Ng and Loosemore (2007), Medda (2007), Zou <i>et al.</i> (2008), Xu <i>et al.</i> (2010)
Construction Risks (CR)	FR4: Inflation risk	Ng and Loosemore (2007), Lam <i>et al.</i> (2007), Bing <i>et al.</i> (2005), Wang and Tiong (2000), Kumaraswamy and Zhang (2001), Shen <i>et al.</i> (2006), Zou <i>et al.</i> (2008), Xu <i>et al.</i> (2010)
	CR1: land conditions	Ng and Loosemore (2007), Lam <i>et al.</i> (2007), Bing <i>et al.</i> (2005), Gallimore <i>et al.</i> (1997)

Construction Risks (CR)	CR2: Labour / materials non-availability	Lam <i>et al.</i> (2007), Bing <i>et al.</i> (2005), Wang and Tiong (2000), Kumaraswamy and Zhang (2001), Shen <i>et al.</i> (2006), Ng and Loosemore (2007)
	CR3: Construction / design changes	Ng and Loosemore (2007), Lam <i>et al.</i> (2007)
	CR4: Construction cost overrun	Ng and Loosemore (2007), Bing <i>et al.</i> (2005), Arndt (1998), Wang and Tiong (2000)
	CR5: Construction completion risk	Ng and Loosemore (2007), Bing <i>et al.</i> (2005), Arndt (1998), Wang and Tiong (2000), Gallimore <i>et al.</i> (1997), Xu <i>et al.</i> (2010)
Operation Risks (OR)	OR1: Residual assets risk	Arndt (1998)
	OR2: Quality of operation	Ng and Loosemore (2007), Arndt (1998), Wang and Tiong (2000)
	OR3: High frequency and cost of maintenance	Bing <i>et al.</i> (2005), Arndt (1998)
	OR4: Operation cost overrun	Ng and Loosemore (2007), Bing <i>et al.</i> (2005), Arndt (1998), Gallimore <i>et al.</i> (1997), Grimsey and Lewis (2002), Shen <i>et al.</i> (2006), Xu <i>et al.</i> (2010)
Market Risks (MR)	MR1: Insufficient income	Bing <i>et al.</i> (2005), Arndt (1998), Wang and Tiong (2000)
	MR2: Fluctuation of material cost (by government or private sector)	Wang and Tiong (2000), Ng and Loosemore (2007)
	MR3: Tariff change	Ng and Loosemore (2007), Bing <i>et al.</i> (2005), Wang and Tiong (2000), Ng and Loosemore (2007)
	MR4: Change in market demand	Ng and Loosemore (2007), Bing <i>et al.</i> (2005), Arndt (1998), Wang and Tiong (2000), Kumaraswamy and Zhang (2001), Grimsey and Lewis (2002), Medda (2007), Zou <i>et al.</i> (2008), Xu <i>et al.</i> (2010)
Legal Risks (LR)	MR5: Market Competition (Exclusivity)	Wang and Tiong (2000), Maslyukivska and Sohail (2007), Zou <i>et al.</i> (2008)
	LR1: Inadequate law and supervision system	Shen <i>et al.</i> (2006), Maslyukivska and Sohail (2007), Xu <i>et al.</i> (2010)
	LR2: Conflicting or imperfect contract	Lam <i>et al.</i> (2007), Wang and Tiong (2000), Bing <i>et al.</i> (2005), Shen <i>et al.</i> (2006), Xu <i>et al.</i> (2010)
	LR3: Need to environmental approval	Valipour <i>et al.</i> (2015)
	LR4: Insolvency of Concession company	Wang and Tiong (2000)

A BOT project comprises various procedures which are affected by several internal/external factors. The critical risk factors identified in this research may not be the strict criteria for every project, yet they were taken through a research process of comprehensive literature review and detailed interviews with local professionals involved in BOT projects.

These critical risk factors were validated through survey research and case studies. The critical risk factors cover a full range of crucial aspects of BOT projects and provide a set of factors that assists in presenting a framework for evaluating and analysing the critical risk factors of the Iranian BOT projects.

3. RESEARCH METHOD

At this paper, we used the DEMATEL (Decision-making trial and evaluation laboratory) method to analyse the cause and effect relationships of critical risk factors (CRFs) of Iranian BOT Projects. Moreover, the Grey System Theory is used to cover the uncertainty of the decision system.

In the grey systems, the word "grey" is applied when the information is partly known and partly unknown. In other words, being "grey" refers to having "incomplete information" (Mierwiak *et al.*, 2018). According to the grey system rules, If X is a universal set and \mathcal{G} a grey set of universal set X , $\underline{\mu}_{\mathcal{G}}(x)$ and $\overline{\mu}_{\mathcal{G}}(x)$ will be defined as the upper and lowest boundary of the \mathcal{G} membership function which is shown in equation (1):

$$\underline{\mu}_{\mathcal{G}}(x):X \rightarrow [0,1] \quad , \quad \overline{\mu}_{\mathcal{G}}(x):X \rightarrow [0,1] \quad (1)$$

The equation $\overline{\mu}_{\mathcal{G}}(x) \geq \underline{\mu}_{\mathcal{G}}(x)$ is completely understandable and changes into a fuzzy set in the form of an equation of the grey set. This shows that the grey theory includes fuzzy and flexible cases when facing fuzzy problems. In the present study, the grey number $\otimes X_{ij}^p$ for P decision is considered to assess the effect of i criterion on j (Asad *et al.*, 2016a, 2016b):

$$\otimes X_{ij}^p = [\underline{\otimes} X_{ij}^p, \overline{\otimes} X_{ij}^p] \quad (2)$$

The grey data turns into a crisp number as following three steps:

Step 1: Normalization:

$$\Delta_{Min}^{Max} = Max_j \overline{\otimes} X_{ij}^p - Min_j \underline{\otimes} X_{ij}^p \quad (3)$$

$$\underline{\otimes} \tilde{X}_{ij}^p = (\underline{\otimes} X_{ij}^p - Min_j \underline{\otimes} X_{ij}^p) / \Delta_{Min}^{Max} \quad (4)$$

$$\overline{\otimes} \tilde{X}_{ij}^p = (\overline{\otimes} X_{ij}^p - Min_j \underline{\otimes} X_{ij}^p) / \Delta_{Min}^{Max} \quad (5)$$

Step 2: Calculate the total normalized crisp number:

$$Y_{ij}^p = \frac{(\underline{\otimes} X_{ij}^p (1 - \underline{\otimes} X_{ij}^p) + (\overline{\otimes} X_{ij}^p \times \underline{\otimes} X_{ij}^p)}{1 - \underline{\otimes} X_{ij}^p + \overline{\otimes} X_{ij}^p} \quad (6)$$

Step 3: Calculate the crisp number:

$$Z_{ij}^p = Min_j \underline{\otimes} X_{ij}^p + Y_{ij}^p \Delta_{Min}^{Max} \quad (7)$$

Equation (8) is used to turn the opinions into a unified viewpoint:

$$Z_{ij}^p = \frac{1}{p} (Z_{ij}^1 + Z_{ij}^2 + \dots + Z_{ij}^p) \quad (8)$$

On the other hand, the DEMATEL method is used to build cause and effect graph of CRFs, which is based on the assumptions of a system including a set of variables and mutual comparisons, and the relationship amongst these variables calculated using mathematical models (Büyüközkan and Çifçi, 2012). In the first step of the DEMATEL method, based on the experts' opinions and the crucial criteria, a direct relation matrix was organized. The obtained T-matrix is an $n \times n$ matrix which demonstrates interactions criteria, as T_{ij} points to the degree of effect of i factor on j factor, $T = [T_{ij}]_{n \times n}$ (Asad *et al.*, 2016a, 2016b).

Next step includes forming the normalized matrix of direct relation (S), $S = [S_{ij}]_{n \times n}$, where $0 \leq S \leq 1$. The matrix S forms according to equations (9) and (10) as follows (Asad *et al.*, 2016a, 2016b):

$$K = \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}} \quad (9)$$

$$S = K \times T \quad (10)$$

Then, the total relation matrix (T) is made by equation (11), where / represent an $n \times n$ identity matrix:

$$M = S(I - S)^{-1} \quad (11)$$

The value of criteria "R" and "D" refers to the sum of rows and columns respectively, calculated by equations (12), (13) and (14) as follows:

$$M = m_{ij}, (i,j=1, 2, \dots, n) \quad (12)$$

$$R = [\sum_{j=1}^n m_{ij}]_{n \times 1} \quad (13)$$

$$D = [\sum_{i=1}^n m_{ij}]_{1 \times n} \quad (14)$$

According to DEMATEL outcomes, to analyse the cause and effect relationships of factors, the criterion (R) represents effectiveness of a factor on other factors, meaning the effectiveness of variables; the criterion (D) for each factor states the impact of other factors on it, meaning the influence of variables; the "Influence" horizontal axis vector (R+D) reflects how important the factor is, and the "Relation" vertical axis (R-D) categorises the factors into a cause and effect group. If the value of (R-D) is positive, the factor will be associated to the cause group, and if negative, it will belong to the effect group (Hung, 2011).

It should be noted that the validity of the instrument used in this research is in some way, a kind of rational validity or content that is related to the applied method. In the paired comparison method, all factors are measured together, which eliminates all the probabilities associated with not considering a criterion or a question. The structure and criteria used in this study were also decided upon by the team members. Moreover, the ability of the tool to maintain its re-

liability over time, despite the controllable condition of the test and the status of the respondents, suggests its stability and least variability. However, according to the type of questionnaire, it should be noted that in this type of questionnaire, all criteria and factors are measured in a two-way manner. In other words, the maximum possible questions are asked with the desired structure of the respondent, so there is no need to measure reliability since all the criteria are considered and the designer is not capable of specific orientation in the design of the questions.

Contrasting AHP technique using the consistency ratio (CR) to test for the consistency of the decision makers' judgment, the DEMATEL approach has not the CR assessment to confirm if the comparisons presented by decision makers are consistent (Lee *et al.*, 2018). Shieh and Wu (2016) suggested a combined method of using corrected item-total correlation and split-half approaches to assess the consistency of the study data. Nevertheless, their research result is to find those experts who have different views than others.

Those experts with different views might have unparalleled views to be considered, or their unreliable views should be eliminated. There is no transparent process to decide if each decision maker's view is valid hitherto for the DEMATEL approach. For example, the available research papers of Professor G.H Tzeng, a specialist in DEMATEL approach development and utilization, suppose the decision makers' views are valid with no more checking the reliability of the research results (Liou *et al.*, 2008; Lu *et al.*, 2013; Chang *et al.*, 2015).

4. RESEARCH FINDINGS

In the present study, according to the related literature and research background, the risk factors of the Iranian BOT

projects were collected, then the opinions of local experts and practitioners were asked through a questionnaire, and finally 27 risk factors were identified and grouped into six main risk factors. Then, to analyse the cause and effect relationships of critical risk factors, a questionnaire was designed with one-by-one questions, in which local experts and practitioners were asked how each factor affected the other ones, using five-point linguistic variables (no effect, very low effect, low effect, high effect, very high effect). The experts were selected from those who had at least one executed BOT project. Finally, 20 completed questionnaires were collected to analyse the cause and effect relationships among the risk factors via a Grey-DEMATEL method. Table 2 shows the demographic statistics of respondents.

Table 2. Demographic statistics of respondents

Gender		Age (year)				Education			Experience (year)					
Male	Female	Under 30	30-40	40-50	Over 50	BA	MA	PhD	1-5	5-10	10-15	15-20	Over 20	
13	7	4	4	7	5	3	8	9	1	2	4	5	8	
Number of BOT project executed						Organization category								
1	2	3	4	5	Over 5	Public sector authorities			Concessionaire		Lender/bank			
1	1	2	3	5	8	7			8		5			

Table 3. Linguistic scales of factors' weight importance and their Grey values

Linguistic variable	Grey values
No affect	[0,0]
Very low affect	[0,0.25]
Low affect	[0.25,0.5]
High affect	[0.5,0.75]
Very high affect	[0.75,1.0]

According to Table 2 statistics, the respondents have adequate experience and knowledge in BOT projects in Iran. Therefore, the information provided on BOT projects by these respondents' organizations is declared to be reliable.

Next, having gathered all the completed questionnaires, the linguistic variables were converted to a grey range of values (Table 3), then according to equations (3) to (7), grey numbers were converted to crisp numbers and all points of view were turned into a single viewpoint by equation (8).

In the next step, the crisp numbers were normalized in DEMATEL using the equations (9) and (10), and total matrix of each of the main factors and their sub-factors were calculated using equation (11). In the end, the values of R, D, (R+D) and (R-D) were calculated. Table 4 shows the results.

Table 4. Results of the cause and effect analysis of risk factors of the Iranian BOT projects

Factors	R	Rank	D	Rank	R+D	Rank	R-D	
Political Risks	6.873184249	1	5.647225244	4	12.52040949	1	1.225959005	
Financial Risks	4.303456399	6	6.695509354	1	10.99896575	6	-2.392052955	
Construction Risks	5.524303445	5	6.576264501	2	12.10056795	3	-1.051961056	
Operation Risks	5.613447936	4	6.308812406	3	11.92226034	4	-0.69536447	
Market Risks	6.575576393	3	4.926920244	6	11.50249664	5	1.648656149	
Legal Risks	6.842817835	2	5.578054508	5	12.42087234	2	1.264763327	
Political Risks (PR)	PR1	6.450060363	1	3.606189698	5	10.05625006	5	2.843870665
	PR2	5.915737306	3	7.084174575	1	12.99991188	1	-1.16843727
	PR3	6.03765097	2	5.442804149	3	11.48045512	3	0.594846821
	PR4	4.818635494	5	5.420142044	4	10.23877754	4	-0.60150655
	PR5	4.931266802	4	6.600040467	2	11.53130727	2	-1.668773665
Financial Risks (FR)	FR1	3.009721568	2	4.17939707	1	7.189118638	2	-1.169675502
	FR2	2.858712155	4	2.54553685	3	5.404249005	3	0.313175305
	FR3	2.877411169	3	2.142787104	4	5.020198273	4	0.734624066
	FR4	3.92555671	1	3.803680579	2	7.729237288	1	0.121876131
Construction Risks (CR)	CR1	1.699766841	5	0.784166379	5	2.483933219	5	0.915600462
	CR2	2.958807098	3	1.441194223	4	4.400001321	4	1.517612875
	CR3	2.485693897	4	4.350706623	2	6.83640052	2	-1.865012727
	CR4	3.36502738	1	2.536168397	3	5.901195777	3	0.828858983
	CR5	3.069550841	2	4.466610434	1	7.536161275	1	-1.397059593
Operation Risks (OR)	OR1	0.53079729	4	1.219195698	3	1.749992988	4	-0.688398408
	OR2	1.631743011	3	0.695068804	4	2.326811816	3	0.936674207
	OR3	2.269562604	1	1.570992488	2	3.840555092	2	0.698570116
	OR4	2.006603485	2	2.9534494	1	4.960052885	1	-0.946845916
Market Risks (MR)	MR1	1.529629989	4	2.593544897	1	4.123174886	2	-1.063914908
	MR2	2.124444648	3	1.66176649	4	3.786211138	3	0.462678157
	MR3	2.512171834	2	1.261949939	5	3.774121773	4	1.250221896
	MR4	2.640476765	1	1.853965019	3	4.494441784	1	0.786511746
	MR5	0.693252934	5	2.128749825	2	2.82200276	5	-1.435496891

Legal Risks (LR)	LR1	1.817719938	1	0.816038493	4	2.633758431	1	1.001681445
	LR2	0.902824104	2	1.23711658	1	2.139940685	2	-0.334292476
	LR3	0.853227558	3	1.122177177	2	1.975404735	3	-0.268949618
	LR4	0.681122935	4	1.079562286	3	1.760685221	4	-0.398439351

Finally, the causal diagram for all main risk factors and their sub-factors were drawn through (D+R, D-R) dataset, illustrated in Figure 1 and Figure 2. The diagram represents the ability to recognize remarkable factors as well as the realization of the factors that have more influence on the other factors in the system (Govindan *et al.* 2016).

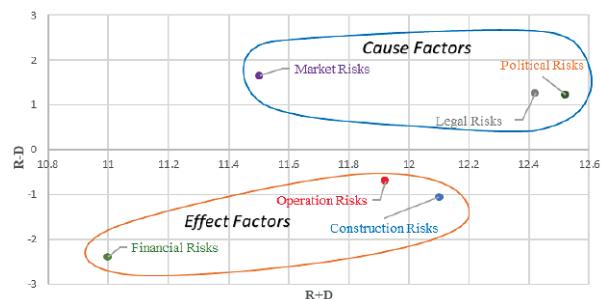


Figure 1. Cause and effect diagram for the main risk factors of BOT projects in Iran

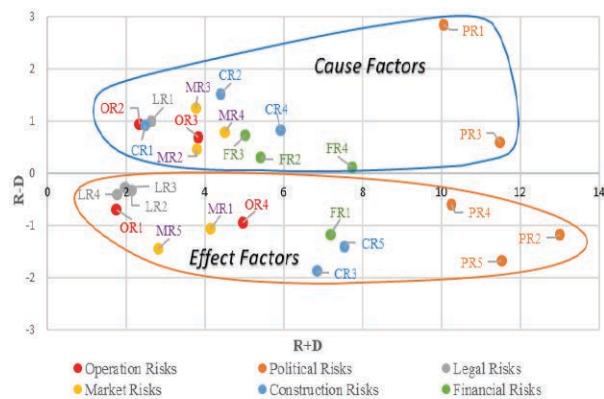


Figure 2. Cause and effect diagram for all the risk groups' sub-factors of BOT projects in Iran

According to Table 4 and Figure 1, the results for the six main risk factors demonstrate that "Political Risks" concerning the R criterion has the most considerable influence on other main factors. Concerning the (R+D) criterion, the factor also has the most interaction with the other main factors, demonstrating its great importance in BOT projects. Furthermore, regarding the D criterion, "Financial Risks" are most affected by other main factors. Moreover, with respect to the (R-D) criterion, the main factors of "Political Risks", "Market Risks" and "Legal Risks" are the causal factors (positive), and the main factors of "Financial Risks", "Construction Risks", and "Operation Risks" are the effect factors (negative).

As is evident in Table 4 and Figure 2, in the first leading group, "Political Risks", "PR₁" is the most influential factor; "PR₂" is most affected by other factors; it also has the most interaction with the other factors, demonstrating the great importance of this factor in the group. Besides, it is discovered that "PR₁" and "PR₃" are causal factors, while "PR₂", "PR₄" and "PR₅" are effect factors in the group.

In the second leading group, namely "Financial Risks", "FR₄" is the most influential factor; it also has the most interaction with other factors, showing its pivotal role in the group. It is also revealed that "FR₁" is most affected by other factors. Furthermore, "FR₂", "FR₃" and "FR₄" are known as causal factors and "FR₁" known as an effect factor.

In the third leading group of "Construction Risks", "CR₄" is the most influential factor; "CR₅" is most affected by other factors; and also has the most interaction with the other factors, proving its great significance in the group. Moreover, "CR₁", "CR₂" and "CR₄" are causal factors, while "CR₃" and "CR₅" are effect factors.

In the fourth leading group, "Operation Risks", "OR₃" (High frequency and cost of maintenance) is the most influential factor in this group concerning R criterion. In terms of D criterion, "OR₄" (Operation cost overrun) is most affected by

other factors; and has the most interaction with the other factors regarding (R+D), which underpins its great among the others. Plus, concerning the (R-D) criterion, “OR₂” and “OR₃” are causal factors (positive) in this group, yet “OR₁” and “OR₄” are categorized as effect factors (negative).

In the fifth leading group of “Market Risks”, “MR₄” is the most influential factor; this factor also possesses the most interaction with the other factors, indicating its exclusive role in the group. Additionally, “MR₁” is most affected by other factors. Also, it is discovered that “MR₂”, “MR₃” and “MR₄” are causal factors, while “MR₁” and “MR₅” are effect factors.

In the sixth leading group, namely “Legal Risks”, “LR₁” is the most influential factor; it also has the most interaction with the other factors, which demonstrates its great importance among the others. Moreover, “LR₂” is mostly affected by other factors. It is determined that “LR₁” is a causal factor and on the other hand, “LR₂”, “LR₃” and “LR₄” can be considered as effect factors.

5. CONCLUSION

The current study applied the DEMATEL approach to analyse the cause and effect relationships of the risk factors of the Iranian BOT projects. One of the unique features of applying Grey theory to this method is considering the initial data as a range of uncertain numbers (Grey numbers) (Asad *et al.*, 2016a, 2016b). In other words, the use of Grey theory system makes it possible to consider the uncertainty in the structure of the decision-making system. Furthermore, the application of decision-making trial and evaluation laboratory (DEMATEL) approach assists the decision makers to recognize causal factors and sub-factors and helps figure out the relative cause-effect relationships between factors and sub-factors.

Due to the DEMATEL analysis outputs (R, D, R+D, and R-D), we can assume that the research findings could be divided into four measurements namely “dominance or effectiveness”, “impressionability or influence”, “superiority”, and “cause/effect” roles.

Given to the criterion “dominance or effectiveness”, factors with the most dominant feature in each group are: “Sanctions”, “Inflation risk”, “Construction cost overrun”, “High

frequency and cost of maintenance”, “Change in market demand”, and “Inadequate law and supervision system”. These factors have a leading role in their group and affect other criteria meaningfully, so they need to be carefully considered by Iranian project managers (PMs) in BOT project risk management.

According to the criterion “impressionability or influence”, factors with the most impressionability characteristic in each group are: “Expropriation and nationalization”, “Limited capital”, “Construction completion risk”, “Operation cost overrun”, “Insufficient income”, and “Conflicting or imperfect contract”. These factors have a sensitive attribute and are most affected by other criteria in their group; therefore, they need to be carefully reflected and planned by Iranian PMs in the BOT project risk management.

Concerning the most crucial criterion “superiority”, factors with the supremacy characteristic in each group are: “Expropriation and nationalization”, “Inflation risk”, “Construction completion risk”, “Operation cost overrun”, “Change in market demand”, and “Inadequate law and supervision system”. These factors have a superiority quality, which leads to having the most interactions with other criteria in their group; thus, they necessitate to be very well-thought-of within the BOT project risk management by Iranian PMs.

Moreover, according to the grouping of factors into “cause” and “effect” groups, the most indispensable cause factors in each leading group are: “Sanctions”, “Foreign currency exchange”, “Labour/materials non-availability”, “Quality of operation”, “Tariff change”, and “Inadequate law and supervision system”. These factors have a causal relationship with the other criteria in their group and could be attained to assist the managers/decision-makers to have a greater understanding of the complicated problems. Furthermore, the essential effect factors in each leading group are: “Termination of concession by Government”, “Limited capital”, “Construction/design changes”, “Operation cost overrun”, “Market Competition (Exclusivity)”, and “Insolvency of Concession company”. Nevertheless, there are situations (for instance in the group “Construction Risks”) that some causes such as “land conditions” and “Labour/materials non-availability” are less important than the effect factors including “Construction completion risk” and “Construction/design changes” that are crucial factors to be considered, they are also required to be paid more attention, since they

are the roots of the problems and have a considerable impact on the effect factors.

Finally, From the six main risk factors viewpoint, the most dominant factor is "Political Risks" which shows that it has a leading role among the main criteria and affects other risk factors meaningfully; therefore, it needs to be well-thought-out by Iranian PMs and decision-makers in the BOT project risk management. In addition, the factor with the most impressionability and simultaneously with the most priority is "Financial Risks" which indicates that while it has sensitivity and most affected from other factors among the main factors, has a superiority characteristic which leads to be the most interactional with other factors among the main factors, thus it needs to be cautiously considered and planned by Iranian PMs and decision-makers in the BOT project risk

management. Moreover, the cause factors in the leading group are "Market Risks", "Legal Risks", and "Political Risks", while the effect factors are "Financial Risks", "Construction Risks", and "Operation Risks", which all could be attained to assist the managers/decision-makers to improve their comprehension of the complicated problems.

As the bottom line, this study provides another viewpoint to prioritize critical risk factors of BOT projects without the assumption of factors and sub-factors being mutually independent. Every action taken on net causes (factor/sub-factor) will have direct/indirect impacts on the corresponding net receivers (factor/sub-factor). Consequently, the decision makers can give more credit and allocate more resources to cause factors and sub-factors to manage essential risks of BOT projects in Iran effectively.

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Weak Mandates Impact on Construction Projects-ex-post Evaluation of Norwegian Public Buildings

ABSTRACT

This paper presents the findings of a study that has looked into 19 Norwegian public construction projects with the intent to examine the correlation between the relative strength or weakness of the project mandate and the development of cost estimates through a project's phases. In addition to the desktop study of the 19 projects, we have conducted in-depth interviews. These case studies also look into the duration of the planning, engineering, and the construction phase and the correlation between time and construction cost.

The study examined projects whose estimates are below the threshold for The Norwegian scheme for quality assurance of major public investments (the QA scheme). The project sample, consisting of projects between approx. €7M and €75M, has allowed the authors to find out whether the execution of public construction projects under a less rigid quality assurance system differs from projects that have undergone the national QA system. The relative strength of each project mandate was subjectively assessed against parameters related to the project's scope, assumptions, and constraints. On average, the project mandates were found to be weak, often with poorly defined scopes and unrealistic constraints. The development of cost from the estimate pre-design to completion showed an increase of 30%. While the lack of strong project mandates prevented the discovery of any conclusive findings in the study of the correlation between the strength of the project mandate and cost,

we believe that this paper presents novel insight into how smaller projects that have not gone through a rigid QA system behave.

Keywords: Project Mandate; Project Initiation; Project Cost; Project Duration

1. INTRODUCTION

It is easy to assume that a project that does not have a good and well-defined project mandate will run longer and cost more, but is this true? The World Bank assessed 1000 projects in 1996 [1]. This assessment showed that 80% of the well-defined projects in the initiation phase were successful compared to only 65% of the less defined projects was successful. The World Bank study showed that a well-defined project in the initiation phase is not equal to a successful project, but it increases the probability for a successful project. Norway has since 2001 had a Quality Assurance system for large public projects and a research project that follows up on the results of the QA system - the Concept program. All public projects with an estimated cost of over approx. €80 m (750 MNok) must go through two quality checks; Quality Assurance 1 (QA1) and Quality Assurance 2 (QA2). QA1 occurs at the approval of the concept, and QA2 occurs prior to financing approval from parliament. This study looks into the project mandate issued for 19 construction projects between approx. €7M and €75M that have not been part of the national Quality Assurance system. All of the examined projects

were initiated and completed between 2003 and 2016. The project mandates were sent by a Norwegian public institution to Statsbygg, the public sector administration company responsible for construction and property affairs, building commissioner, property manager and property developer. Statsbygg is responsible to the Ministry of Local Government and Modernisation (KMD). During a construction project; Statsbygg plans, quality assures, budgets, contracting and follows up construction projects. On behalf of the Norwegian government, Statsbygg owns and manages 2,207 buildings distributed among approximately 570 property complexes at home and abroad, all leased to public sector users.

Projects that has undergone the national QA system uses between 60% to 85% of the project duration on the early phases, which includes idea phase, programming and the feasibility study[2]. The idea phase is on average 43% of all the. The idea phase of building projects constitutes 30-35%. This study has investigated if there is any connection between engineering and construction time, and the time spent on programming and developing the project mandate. This study presents an analytical assessment of each of the project mandates and compares the results with the first estimates and final costs of each project.

The overall purpose of the study was to find out whether smaller projects executed by a public sector administration company under a less rigid Quality Assurance System behaves or delivers differently than larger projects that have undergone the more rigid national QA system.

The following research questions have guided this study;
Research question 1: Has a weak project mandate any correlation with increased construction cost and time we spend on construction of the project?

Research question 2: Are there any differences between smaller projects that have not gone through the Quality Assurance System for larger public projects with regards to construction cost and time?

2. THEORETICAL BACKGROUND

When a project is initiated it is normally based on specified needs or demands from some important stakeholders. Every project is undertaken for a specific purpose. Typically, the project owner has a goal that should be satisfied through the results of the project. In a classic project delivery process, the owner identifies the business need and develops it to a level of detail where a separate organization can take over and deliver the results. The owner and the project delivery organization then enters into a contract or a mandate. Preferably with as precisely as possible descriptions of deliverables within an agreed time and cost constraint. The project organization then executes the project and delivers the results to the owner. The owner then enters an operational phase where the results are exploited to his benefit and to fulfill his business goals [3].

According to PRINCE2™ it is vital for a successful project start-up to start with a business case (BC) and that there is a strong connection between the BC, mandate and the project brief [3]. Moreover, the BC should provide a description of how this project supports business strategy, plans or programs. This ensures a description of the customer's quality expectations, the most important acceptance criteria and highlights the largest risk factors. The mandate may, in the beginning, be verbal requests or a formal document which defines in high-level terms the reasons behind the project and what outcomes are sought. According to PRINCE2, the

Table 1. PRINCE2 project mandate

Typical Content	Description
The Scope of the project	Expressed in terms what the project shall deliver and what it shall not deliver
Assumptions	If any, what kind of assumptions has been made
Known risk or issues	Any risks or issues that the project team should know about prior to start
Constraints	Typically, budget or time constraints for the projects

initiation phase is built around three elements: developing the project brief, designing and appointing the project management team, and creation of the initiation stage plan.

According to PRINCE2 a project mandate can simply be a verbal instruction to start a project, still it should include as a minimum the information as shown in Table 1 – PRINCE2 project mandate.

The project brief must include high-level information on WHAT needs to be done and WHY, WHO should be involved in the process, and HOW and WHEN it should be completed. The aim of the Project Brief is to allow the Project Board to decide if there is sufficient justification to warrant the expenditure proposed by the initiation stage plan. The Project brief should be tailored to the requirements and environment of each project. And will typically cover project definition, explaining what the project needs to achieve. It will contain, background, project objectives, project scope, outline project deliverables and /or desired outcomes, and should describe exclusions, constraints, and interfaces.

The uncertainty assessments in the front-end of a project are different from the uncertainty debate that goes on in the project management team appointed to deliver a project within a certain specification and within a certain time and budget. In addition, uncertainty management at project owner and top management level in the organization will often have a different focus than that of the project manager and his or her staff. The focus in the front end of a project is typically on finding the best concept that satisfies the stakeholders' needs and that will give the best benefit to the owners and society. For example, when deciding on the best way to cross a fjord, it may be necessary to decide whether a bridge or a new tunnel should be constructed or whether ferry services should continue to run. In this phase, the project management team typically is more concerned about the uncertainty related to the project's objective on the different solutions and in finding the best and preferred solutions. In the front end, the focus is on finding the best concept that should be used in the next stage of the process, based on limited knowledge about how the concept should be built or executed, and how easy or hard it will be to execute the different concepts in practice. The cost and time analysis are typically at an aggregate level with high uncertainty, since the concept is not described or planned in detail at this stage in a project's life cycle. The mutual relations

between different concepts and uncertainty on a more conceptual and aggregate level are often more important than estimating the true expected value of the different concepts in the early stages of the process [3].

Construction costs in public projects are estimated by stochastic cost estimations based on Monte Carlo simulation [4]. This produces probability-based estimates that identify the main risk drivers, and which includes project-specific contingencies. The formally approved budget for public projects such as large public building (Museums, Opera house, University buildings), road and rail projects is set at the P85 level, which means that the risk of cost overrun is estimated at 15 percent and that max 3 out of 20 projects should exceed their approved budgets. The budget for the responsible agency is usually set to the 50 percent percentile (P50). The difference between P50 and P85 is set aside as a contingency reserve for the project at a governmental level, above the agency/contractor that is to construct the project. Compared to a single-point deterministic estimate in which all elements are treated as if they were certain, the P85 would normally be some 20-30% higher while the P50 is about one standard deviation larger [5, 6].

The cost frame approved by the Norwegian Parliament is normally slightly lower than the P85 value. The implementing party will, however, have to manage the project within a lower steering frame, which generally corresponds to the P50 value. The proposed cost frame is normally P85 with deductions for possible simplifications and reductions (reduction list) that can be handled during the project if the cost frame is in danger of being exceeded. The agency's steering frame is lower to avoid incentives for the use of contingency reserves. According to Welde [6] is the average cost growth for a large project from QA1 to QA2 about 40%.

Morris says that the one thing distinguishing projects from non-projects is that all projects, no matter how complex or trivial, go through a common life cycle development sequence [7]. Public projects go through a life cycle consisting of five main phases, each requiring a number of key activities and sequenced in a logical progression. However, in practice, the sequence in which they are carried out can vary, depending on project priorities, the needs of the project and attitude towards risk. Therefore, phases may overlap, but all phases must achieve a major project milestone and can be treated as a separate project [8, 9].

The phases are separated by decision points or gates, the purpose of which is to facilitate project governance seen from the owner's perspective. By the end of the last project phase, the project should have provided all deliverables and is ready to be handed over to the operating organization. A fundamental logic in this perspective is that for each step of the development, one should stop and check the status before moving on. These decision points are called gateways: a formal control of documents and assumptions before making a decision to close one phase and enter into the next. The gateway approach is a key element in an adequate implementation strategy. Seen from an owner's perspective is a decision gate or decision point (a point for looking forward), whereas seen from the constructor's perspective it

may be a milestone (a point for celebration, following accumulated results).

The purpose of a decision gate, as seen from a project owner's perspective, is to ensure that the formal decision-making is successful in supporting the success of the organization, business/corporation or public entity. Broadly speaking, this depends on making the right decisions so that maximum value is secured in the long run for the owners. According to PRINCE2, projects should be delivered in stages, in close collaboration between the project owner responsible for managing the stage boundary and the project management team responsible for the operational planning and execution of the project (see Figure 1).

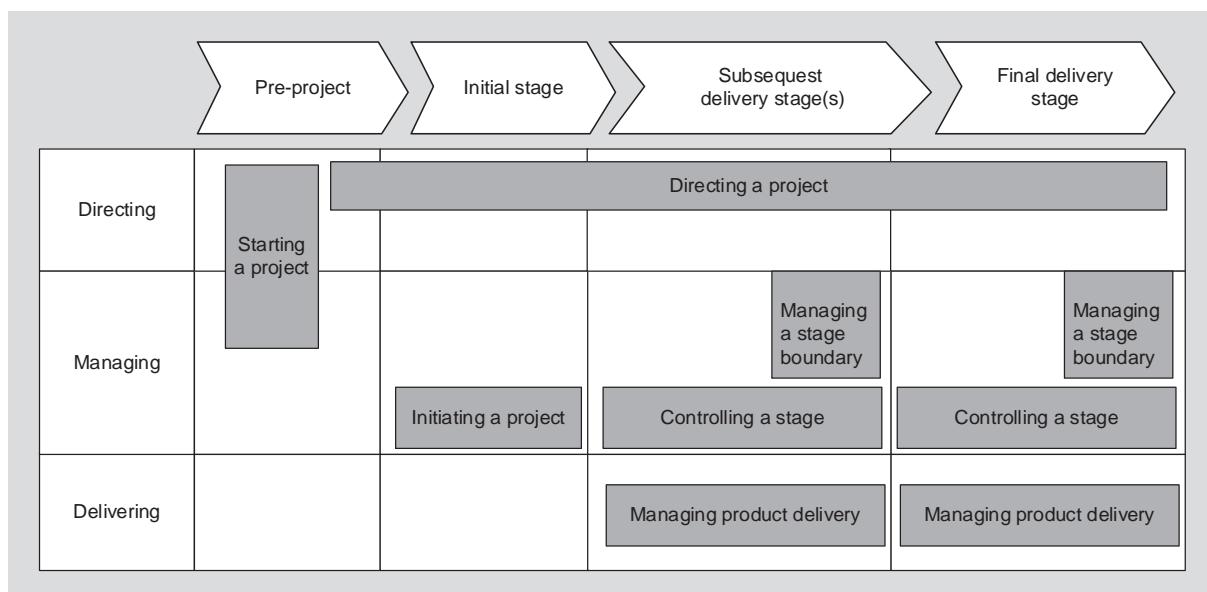


Figure 1. PRINCE2 process model [3]

Many public and private companies have adopted this model, and there is often a clear similarity between the PMI/PRINCE2 stage gate models and the execution models that are used by many private and public companies[9]. The project execution model for the public agency that has been studied in this ex-post study consists of 7 phases with 6 decision gates, as shown in Figure 2.

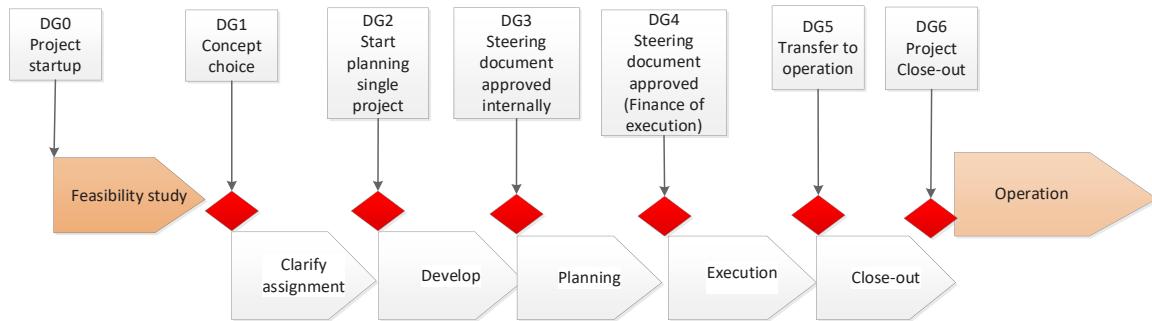


Figure 2. Project execution model – public agency (Statsbygg)

The public agency model shows strong similarities with the models recommended by Morris[7] and the PRINCE2 model [3]. The terminology may differ slightly, but the main point is that the public agency model has clear similarities and the same logic as the standard project management model suggested by Morris and PRINCE2.

Figure 3 presents the overall Norwegian Ministry of Finance project model used for large investments projects in Norway.

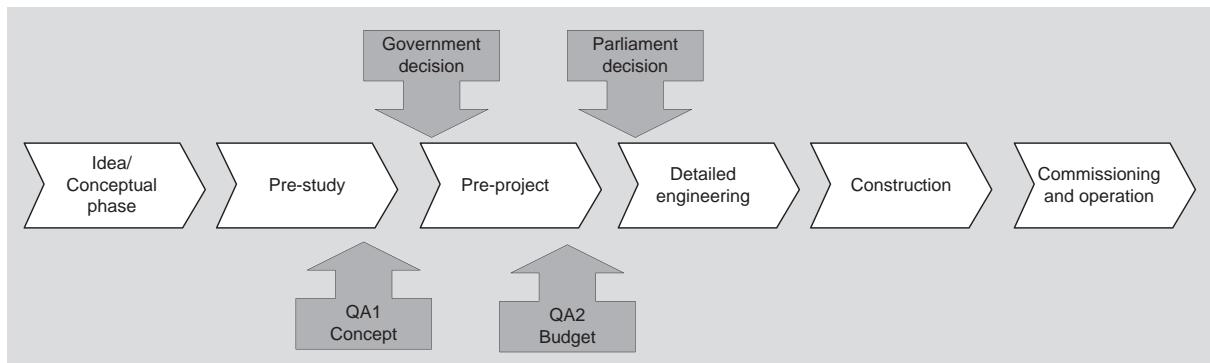


Figure 3. The Norwegian Ministry of Finance project model, from [9]

Individual ministries are normally responsible for new investment initiatives. Investments with a budget in excess of €80M must be analyzed in accordance with the requirements and formats stipulated by the Ministry of Finance. These analyses are thereafter subject to external quality assurance on behalf of the relevant ministry.

The Norwegian Ministry of Finance project model involves two stages. The first stage concerns the actual choice of concept. The agency's evaluation is called a concept selection study. This is subject to an independent assessment of the document and is known as quality assurance of the

concept choice (QA1). At this stage, it will be decided at the government level whether to reject the project or move on to the pre-project phase; and which alternative to choose if the project is to proceed. In the next stage, an overall strategy document is prepared for the project. This includes goals, budgets and target cost, implementation strategy, contract strategy, and other key information. This document is then subjected to external quality assurance with particular focus on the cost estimate and management documentation (QA2). The government will then submit the matter to the parliament, which makes the final decision on financing the project.

3. METHOD AND RESEARCH DESIGN

In this paper, the development of costs and time estimates through a project's life cycle, from the initiation phase to project completion, is studied and analyzed. We started with a sample consisting of 23 small-to-medium sized Norwegian public civil sector construction projects, completed between 2003 and 2015. During the study period we had to reduce the number of projects to 19, due to incomplete datasets. The projects were selected based on the aforementioned time-window and a cost at completion between €3.5M (40MNok) and €75M (750MNok). The study follows a quantitative approach. Data were collected from each project mandate, the management documents at each phase and various data collected in a database owned and run by the Norwegian Directorate of Public Construction and Property Management. The final project budget and funding limit for each project were also collected from the database. Earlier cost estimates were collected from each of the project management documents together with the date of pro-

gression to the next phase. In addition, we conducted interviews with 7 of the project managers to get more in-depth information on how the projects were run and how decisions related to start-up, cost and time was taken in the different phases.

The Norwegian Directorate of Public Construction and Property Management have issued an outline for project mandate to be used as a guideline by other state directorates and ministries. This outline, which in short guides the issuer of the project mandate to address the need which has triggered the project, the project scope, in time, in substance and in cost, and finally the project's objectives provides the structure from which our assessment of the mandate's quality and maturity is made. For each initiation letter, a score between 0-5 is given against each parameter. The assessment is subjective and a score of zero means the parameter is unaddressed in the mandate. For a score of 5 the parameter is covered in great detail. All costs have been index regulated to 2018 equivalents.

Table 2. Description of Parameters

Name	Description of Parameter
Purpose	The purpose of the project, with description of usage, number of people working / visiting and so on.
Anchored	Is the project anchored to a Master Plan
Ambition	What is the ambition level in regards of quality of materials
Environmental Ambition	What is the environmental ambition for the project
Timeframe	When shall the project or phase be completed
Area	The total gross area of the projects
GFA/GIA factor	The factor for Gross Floor Area / Gross Internal Area
Type of Project	New building, rehabilitation of an old build or a combination
Cost	The maximum lease
Finance	How is the project financed, example through the State Budget or over the lease
Societal goals	Describes the benefit or value the project should contribute to society in the longer term
Business goals	Describe the outcomes sought for users of the project's results
Project goals	Describe the project's final delivery

All the projects in the study followed the Statsbygg Project Model (cf. Figure 2).

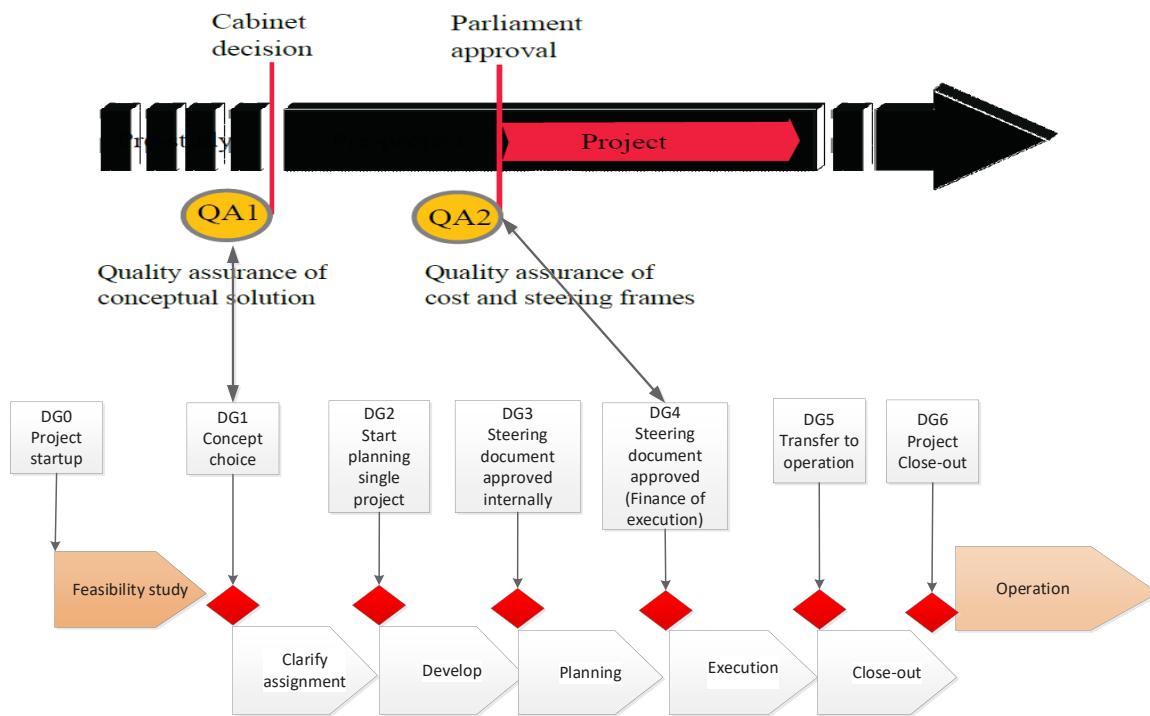


Figure 4. Statsbygg Project Model together with the Norwegian Quality Assurance regime for major public investment projects

Figure 4 shows how Statsbygg model corresponds with the Norwegian Ministry of Finance project model. DG1 correspond with **QA1** concept choice, and DG4 corresponds with **QA2** approved for execution. At DG4 is the financing of the execution phase agreed upon and at DG5 the risk for cost overrun is transferred to the public agency (Statsbygg).

4. RESULTS AND FINDINGS – ARE THERE ANY CORRELATION BETWEEN A WEAKLY DEFINED MANDATE AND COST GROWTH?

For each of the 19 projects, the project mandate was collected. An assessment of the subjective quality and maturity of each project mandate was made to test whether projects with better-defined mandates were less susceptible to cost overruns. We also looked into if there is any connection between the time the project spent on program phase developing the project mandate and the time later spent on engineering and construction.

Figure 5 illustrates how many of the 13 parameters each studied project mandate had addressed. None of the pro-

jects managed to address all of the parameters that Statsbygg recommend. On average, the project mandates only addressed less than half of the parameters that was mandatory in the company project mandate template.

Project #4 addressed 11 out of 13 parameters as in. The diagram shows the scores from the initial project mandate and an updated project mandate prior to construction start (DG4 prior to construction). The initial project mandate is shown in light blue color and the updated project mandate is shown in dark blue color. Illustrates the average score for all 19 projects



Figure 5. project mandate parameters

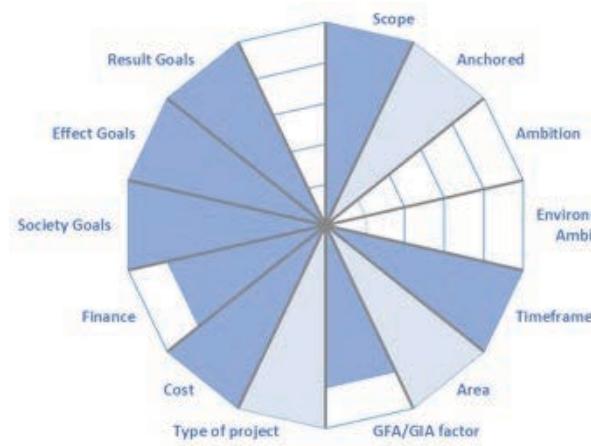


Figure 6. Radar plot project mandate for project #4

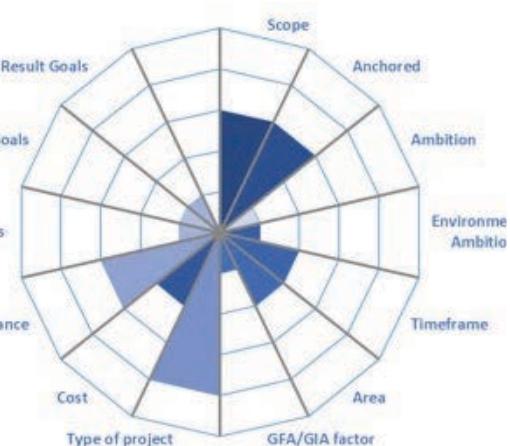


Figure 7. Radar plot Average Score, project mandate

In general, most of the project mandates lacked information about goals and targets, with a few exceptions. Even the project scopes were poorly defined in the project mandate for most of the projects in the study. The timeline established in the project mandate was often misleading and not realistic. In general, our assessment is that the type of project is defined, to a certain extent the purpose and that the project is anchored to a masterplan. According to PRINCE2 at the minimum the project mandate should include the scope of the project and the constraints, even these basic parameters are not covered in all of the projects. About half

the projects did not address the scope or had inadequate descriptions of the scope. Furthermore, most projects did not state any constraints.

Figure 8 illustrates the cost development for medium-sized projects that had an estimated higher construction cost than € 14 M. Figure 8 shows the cost development for smaller projects that had an estimated lower construction cost than € 14 M. For the projects in this Study we generally see a lower increase than other findings on larger Norwegian public projects [5, 6], but still significant increase, on average 30%

between DG3 and DG4. This indicates that while the lack of a good project mandate is still important for smaller projects compared to larger, are still the consequences are higher for the larger mega projects. Some of the projects below € 14 M have been designed to cost. This explains why we do not see a significant increase in costs between the earlier phases and the completed project on these projects. This is a lower cost than in [6], at a later stage in the project, but still a significant increase in cost between DG4 and DG5, between the commencement of construction and project closeout.



Figure 8. Cost Development for projects higher than € 14 M

Project #5, #15 and #16, illustrates an increase in cost between DG4 and DG5, which indicates lack of a clear definition of project mandate which we also see in our findings from the project mandate review. Project #15 and #16 had only addressed 2 and 1 of the 13 parameters. The cost increase was 34% between DG4 and DG5. All projects show a decrease in actual construction cost towards the approved budget.

Project #1, the numbers from this project indicates that the project has not gone through the internal process for cost control and the project has used a design-to-cost philos-

ophy to see if it was possible to accomplish within this estimate. According to the project mandate review the project addressed 5 of 13 parameters. The project mandate did not address the size, cost and finance or any of the Objectives / Goals. Project #14 - had no formal accept of financing before entering the construction phase, indicating that the project did not comply with internal procedures and that the project was designed to cost. For the smaller projects, we see a similar trend as illustrated on the larger projects. An increase between the DG4 and DG5 on most projects, see Figure 9.

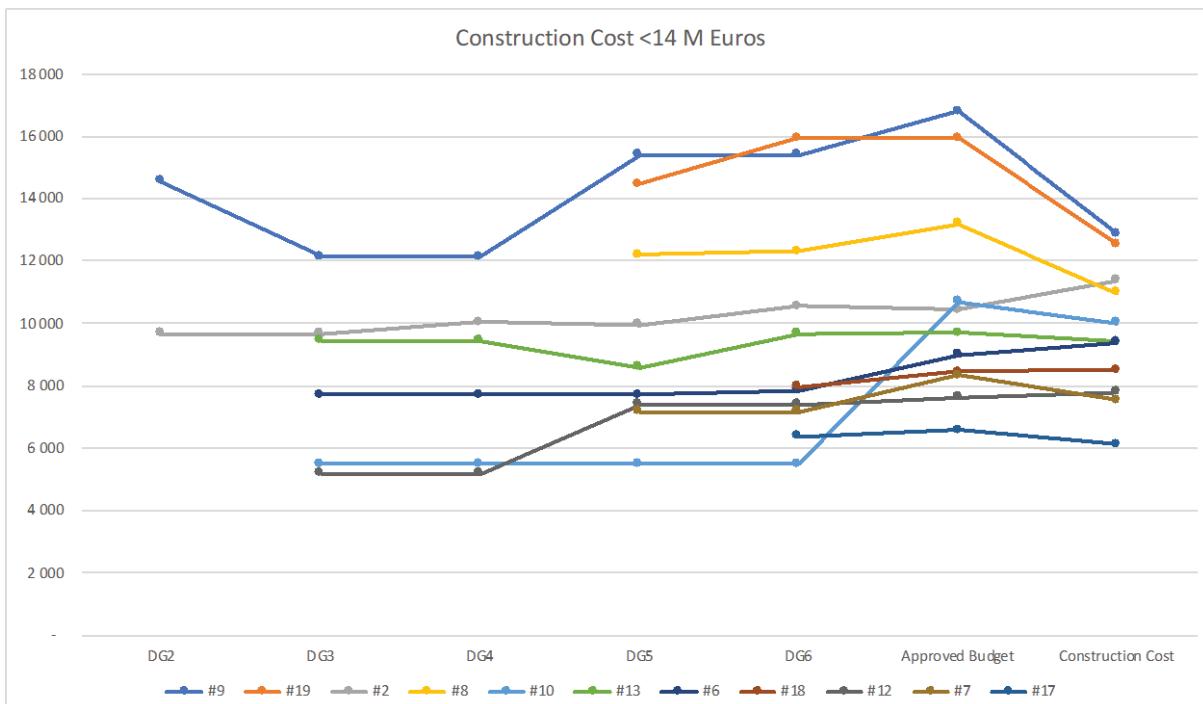


Figure 9. Cost Development for projects lower than € 14 M

Project #3, #4, #9 and #12 illustrates an increase in costs between DG4 and DG5, which indicates a lack of a clear definition of project mandate. Still, project #4 had the best score according to Figure. The other projects have a low score according to Figure 2. Project #3 had a good project mandate, still we see an increase between DG4 and DG5. Project #9 had 2 updates of the project mandate and still it came out with an unclear mandate. Project #12 had a fairly good mandate, with unclear Goals and ambitions.

The average cost increase was 54% between DG4 and DG5. All projects show a decrease in actual construction cost towards the approved budget. Project #9 shows a decrease of 23% between the approved budget and the construction cost. Furthermore, all of these projects had a decrease between the approved budget and final construction cost.

Project #2, #6 and #13, the numbers from these projects indicates it has been a strict design to cost. Project #2 had a good project mandate. Project #6 did not address any of the parameters and project #13 addressed 2 of the 13 parameters. Project #10, had an unrealistic initial internal estimate, the project was supposed to be "design to cost", but due to lack of understanding the complexity of the project,

the cost estimate was too low. No Contractors was interested to bid and then the budget had to be increased with more than 50% between DG5 and DG6. Project #8, #17, #18 and #19; had no formal accept of financing before entering the construction phase this indicates that the Statsbygg project model according to Figure 2 was not followed.

Most of the project mandate was vague, had multiple versions and these versions were not updated with new information. Even if the projects have god project mandate the estimate between DG4 and DG5 are increasing. There is no correlation between this increase and the quality of the project mandate. About half the projects have a significant increase between DG4 and DG5. The total increase for all project is in excess of 30%. Between DG4 and DG5 the detailed engineering occurred, and the customers' demands and need is more specific and specifies and in the end the budget is sanctioned. Due to that Statsbygg takes over the risk after DG5 from the customer, Statsbygg has an incitement to increase the cost at DG5. Statsbygg is carrying all the risk after DG6 and has to cover any cost growth. The difference between DG6 and final approved budget are usually price and currency regulation.

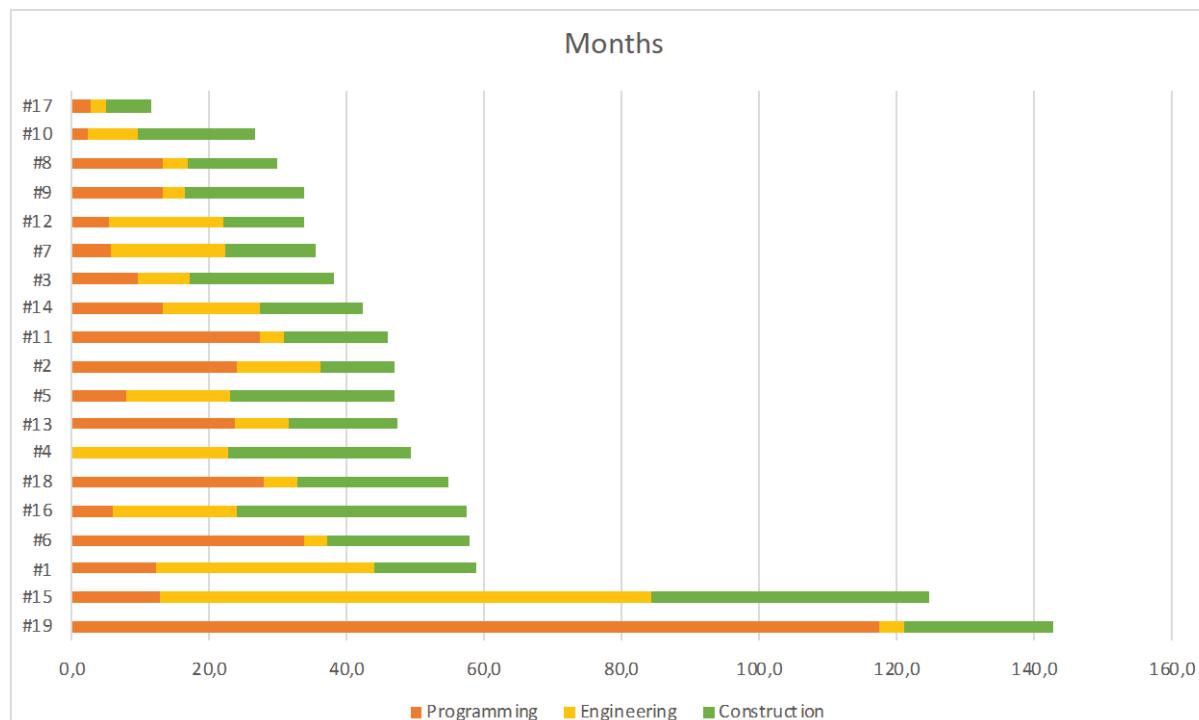


Figure 10. Time use on programming, engineering and construction

According to Statsbygg mandate, Statsbygg shall have a balanced portfolio budget. In light of the results we can see that “the smaller projects pay for the larger projects”. In the sample that has been studied has Statsbygg a surplus of €20M/4% of the total construction cost compared to the approved budget and project finances.

According to Figure 10, if we exclude project #19 and #4, the average programming phase is 14.1 months or 30% of the total length of the project, the engineering phase is 14.1 months or 30% of the total length of the project and the Construction Phase was 18.4 months or 40% of the total length of the project.

Project #15 has had stop during the project and therefore the engineering phase is too long.

Project #19 lacked funding and therefore the programming phase lasted almost 10 years, prior to a short engineering phase.

The construction phase is between 1 and 2 years for most of the project in the study, only one project spends less than one year; project #17, two project spends more than 3 years; project #15 and #16. On average the project builds for €1.02 Mill per month – the large projects spend on average €1.51 M per month, which is approximately 2.3 as much per month than the smaller projects. The small projects spend €0.68 M per month. This shows that time we use in the construction phase correlates with how much money the projects on average spent per month.

Due to it takes a few months to start up the construction phase, the average spending per month for smaller projects will be lower compared to a larger project. Therefore, the average spending during construction doesn't tell the whole story on how effective and fast the construction phase has been for smaller projects.

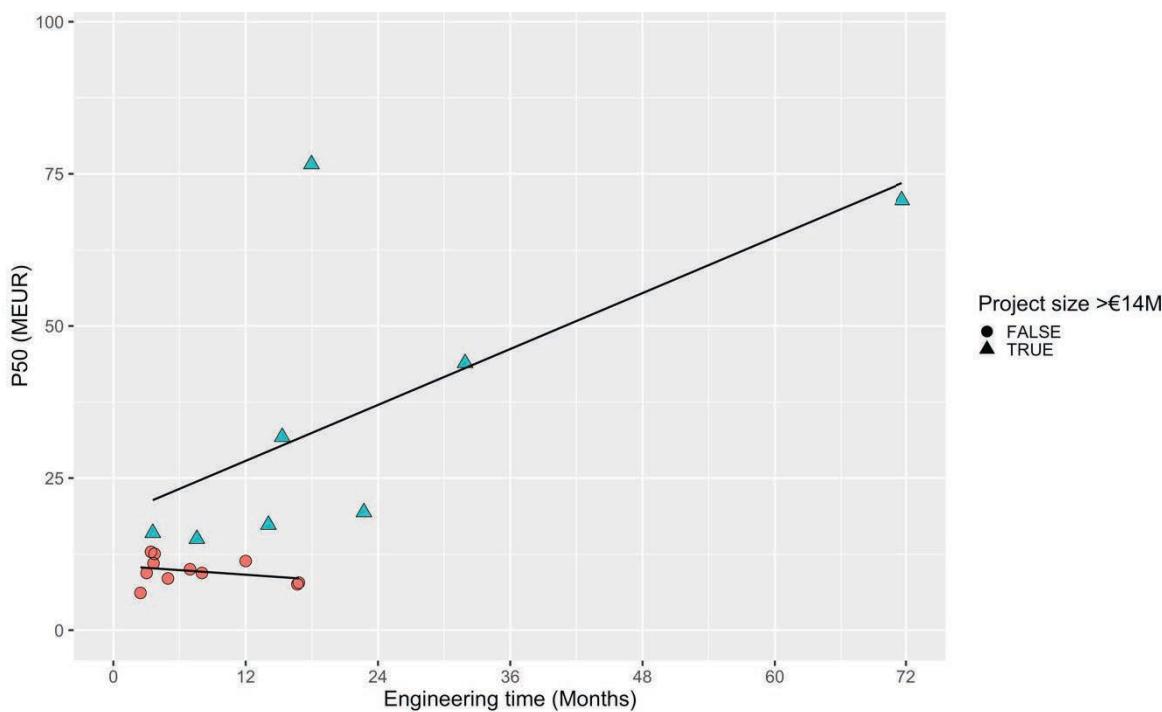


Figure 11. Duration of engineering vs % of the final cost at DG3 -project >€14 M

Blue triangles in Figure 10 and Figure 11 indicates projects above €14M in construction cost. Red circles in Figure 10 and Figure 11 projects less than €14M in construction cost.

Rather more interesting is comparing engineering time with construction cost. This study shows that projects under €14M spent between 2.5 months and 16 months on engineering. The larger project distribution has a larger deviation – between 3 and 72 months. The cost growth and the ability to deliverer the project on the approved budget seems to weakly correlate with the time used on planning and the lack of a clear project mandate.

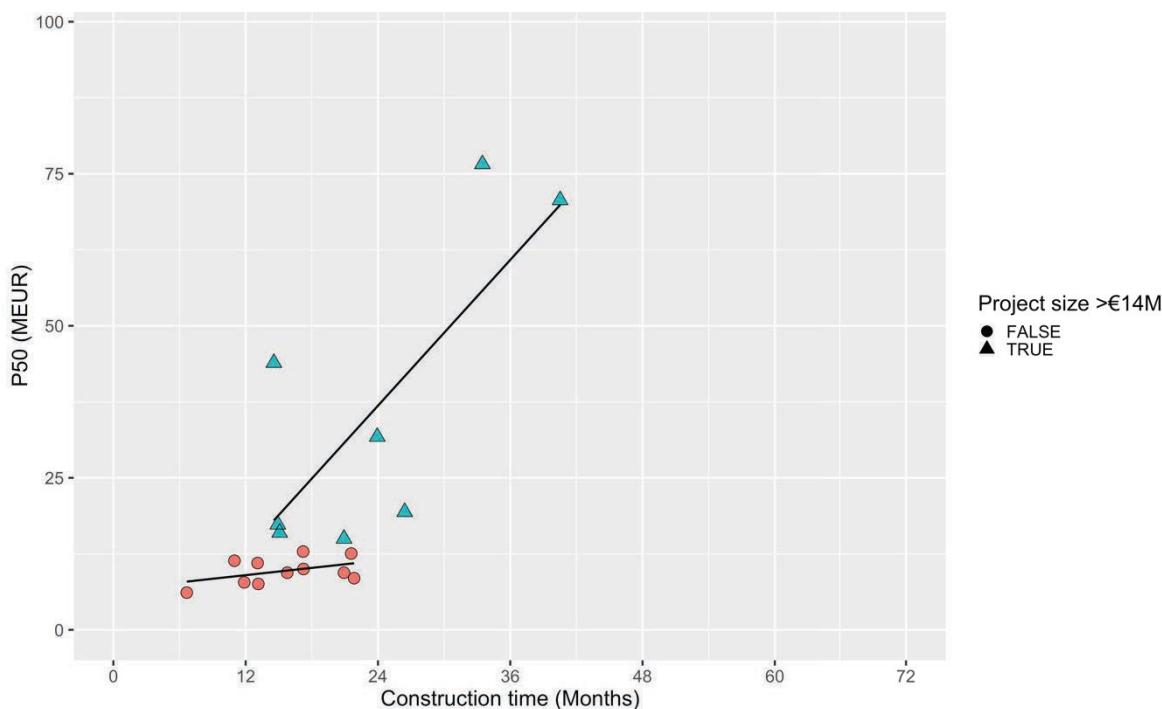


Figure 12. P50 (Cost) Construction duration vs. Money used per (Months) project >€14 M

This study shows that projects under €14M spent between 6 and 20 months in construction. The larger projects have even larger variation – between 12 and 40 months on the construction phase. There was also large deviation on how much money the larger project spent per month- from project #3; €0.7M per month and 21 months construction to project #1; €3M per months and 14.6 months construction.

The small-and-medium-sized projects in our study follow the same pattern as the large project study[2]. The programming and engineering phase consume 60 % of the overall project time and the construction 40 %. This means that smaller project seems to have a slightly simpler path for starting up- and that the programming phase goes slightly faster when the projects are smaller and less complex.

5. DISCUSSION AND CONCLUDING REMARKS

In this study, we have seen that projects have spent approximately 30% on the programming phase, 30% on the engineering phase and about 40% of the duration on the construction phase. The construction phase is between 2 and 3 years for most of the projects. Compared to large public construction projects we see a similar time spending between the different phases[2]. The difference is that [2] includes the idea phase into their time study, which we did not have the opportunity to include, due to a lack of data in our projects.

On average the Projects spends €1.0 M per month. The larger projects spend on average €1.5M and the smaller projects spend €0.7M. This indicates that larger projects are more effective than smaller projects. Since projects generally need some time before becoming effective the small projects will have a lower cost per month compared to the larger projects. Still, a difference about 2.3 is too high and shows that smaller projects are less effective.

It is easy to assume that a project without a good and well-defined project mandate will run longer and cost more, but is this true? According to this study, most of the projects had a vague project mandate and most of the project has a small increase in the cost estimate between the start of

engineering and end of construction. Still there were some that had a well-defined project mandate and still had the same increase between the early phase estimate and cost estimate just prior to construction.

For the projects that have not gone through the QA system, we can see an increase after detailed engineering. Projects that have gone through the QA system, seems to have an increase at an earlier stage in the project (prior to detailed engineering) than those who have not. This indicates that the QA projects become aware earlier what the real cost may become in the end. For the smallest projects (approx. <€10M) the project philosophy has been “design-to-cost” and we do not see a significant increase or decrease in the estimates.

This study has the following conclusions:

1. The project mandates are of varying quality and often does not include essential information that should be present at the start of the Project

The studied project mandates showed varying qualities and did not include the basic information that Statsbygg are asking for. The project managers had to clarify the project mandate through dialog and meetings with the client prior to the project startup. The project mandate was seldom updated, but changes were tracked through meetings and correspondences. During the interviews, the project managers stated it was a great deal of trust between the clients and Statsbygg for these projects. Since Statsbygg is not supposed to earn money on these projects, the clients have genuine trust that Statsbygg is not trying to be unreasonable and earn money on the projects.

2. All projects are underestimated in earlier phases compared to the final cost

All the projects are underestimated in the earlier phases, the same can be seen in large projects that have gone through the public QA-system. During interviews, it was identified that the main reason for underestimating is lack of project goals and that the future needs are not properly identified in the project mandate.

3. A well-defined project mandate gives the opportunity to get a good first cost estimate

This study shows that most of the project had a too low first cost estimate. According to the project managers, this could be prevented with good project mandate that defined the needs and goals of the projects. Still a concern is that the clients didn't have the know-how to define these needs and goals, so some corroboration between the client and Statsbygg is still required. According to the interviews, most of the changes to the first cost estimate is due to a lack of project goals and increased demands from the clients.

4. Projects gone through the public QA-system, shows an increase in their cost estimates earlier in the timeline compared to the projects that have not gone through the QA system

There is a clear indication that projects that have undergone public QA, shows a better cost estimate at an earlier stage in the process compared to smaller projects. However, the length of the programming phase is often significantly longer, which is an indicator that the project mandates are better developed at that stage compared to those of the smaller projects.

5. Projects goals are usually not included in the project mandate

Most of the projects in this study did not have any goals in their project mandate. The project managers blamed the client's ability to look at the future needs when they wrote the project mandate. This led easily to misunderstandings between the client and Statsbygg when it came to the project needs and goals.

6. There is no correlation between a poorly defined project mandate and the length of the design phase

The interviewed project managers stated that the programming phase was usually too extensive in regards to length. The clients usually did not consider it essential to follow Statsbygg project plan and therefore did not have a plan of how to provide Statsbygg the required information they needed to finish the programming phase. Statsbygg does not own the progress in this phase and therefore time extensions are common during this phase. This has led partly

to the new project model that Statsbygg is currently using for their projects. The new project model includes project gates that need to be fulfilled before the project can go further, with clear deadlines for both the client and the project.

7. There is no indication that an unclear project mandate gives cost growth and overruns

According to this study, there is weak to no correlation between an unclear project mandate and cost growth and overruns. According to the project managers, there has been some misunderstanding about the scope and the final lease due to unclear project mandates. This has introduced friction between the client and Statsbygg, perhaps especially when the final lease is to be negotiated.

It is also important to mention that Statsbygg takes over the cost risk for the project at DG5, which gives Statsbygg an incentive to increase the budget at DG5. Usually, the client is paying for the project through their lease over 20-25 years. Still, a good and clear project mandate will give the correct cost estimates earlier in the process and can also make sure there are fewer misunderstandings between the clients and Statsbygg.

8. On average a construction phase lasts between 1 and 2 years regardless of the size of the project

No matter the size of the project the construction phase last between 1 and 2 years. There is a potential to reduce the construction phase for smaller projects with better planning, there is no indication that this relationship is linear.

9. Smaller projects have less efficient spending than larger projects

We can see that smaller project in this study are less effective - meaning they spend less money per month than medium-sized projects, during the construction phase, especially during the ramp-up of the project regardless of whether the project is small or medium sized.

10. An extended programming phase does not guarantee a shorter engineering phase

There is no indication that a long programming phase gives a shorter engineering phase or a more complete project

mandate. The long programming phase according to the interviews are an indication of lack of clear goals and that future needs of the building have not been well defined by the client.

Research question 1: Has a weak project mandate any correlation with increased construction cost and time spent on construction of the project?

According to this study we have seen that the quality of project mandates has been varying and not at acceptable standards. Most of the project mandates have lacked goals and even a decent description of the purpose of the project. Still, we have not found any correlation between a weak project mandate and cost and time spent on a project.

During the interviews, it was unveiled that there is a large degree of trust between Statsbygg and the client. During the earlier phases of the project, the project managers usually had multiple meetings with the client. Also, any changes during DG4 and DG5 was mostly treated as client-driven changes. This meant that the construction budget was increased due to the changes and the project avoids overruns. Since these projects are client financed over a lease, the client only needed to accept the increased lease over

typically 20-25 years instead of paying the whole change cost directly.

Research question 2: Are there any differences between smaller projects that have not gone through the Quality Assurance System for larger public projects in regard to construction cost and time?

Projects that have gone through a more rigid quality assurance show an increase in their cost estimates earlier in the project timeline compared to projects that have not gone through the QA system. This study shows that the smaller projects that have not gone through the public quality assurance system are equally well run compared to the projects that have gone through the QA system. The smaller projects are doing less administrative work but are generally well planned and on budget and time.

We believe this paper contributes to the theory with novel insight on how smaller projects that have not undergone a rigid QA system behaves. Consequently, smaller projects may benefit from a QA system if there is a need to see more realistic estimates earlier on in the process. This study indicates that there is no correlation between unclear project mandates and budgeting during the different phases.

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Four Stages of Making Project Management Flexible: Insight, Importance, Implementation and Improvement

ABSTRACT

Increased project complexity, project dynamics and changes in clients' requirements are a few examples that suggested the necessity of flexibility in project management to deliver successful projects. Despite the fact that literature suggests adding flexibility to project management, there is no existing framework which provides a practical process of how to add flexibility into the practice of project management. Therefore this research aimed at investigating how project management could become flexible and whether such flexibility would improve project performance. The research question is: how to embed flexibility in the practice of project management in early project phases? To answer the research question four sub-questions were formulated which have been separately researched. This main question was answered by proposing a flexibility framework. This framework comprises four stages: understanding the current situation, practitioners' perspectives on flexible project management, choosing enablers to become flexible, applying selected enablers to improve project performance. It can be concluded that trust appears not only to be an enabler of flexibility in project management but an existing perspective among the practitioners regarding the concept of flexibility. This perspective puts the emphasis on 'trust' as the most important enabler of flexibility. Moreover, the positive contribution of 'trust' to project performance is acknowledged in this research. Considering the movements towards flexibility and adaptability concepts, this research fills the gap in the literature by providing a practical project management flexibility framework. Moreover, it provides a step-by-step guideline for practitioners to embed flexibility in practice.

Keywords: Flexible Project Management; Agile Project Management; Early Project Phases; Project Performance

1. INTRODUCTION: 'FLEXIBILITY' AS A PARADIGM SHIFT IN PROJECT MANAGEMENT

Projects are influenced by their complexities in two ways: positively in terms of defining new opportunities and negatively in terms of threats. Therefore, management of project complexity can focus on maximising the opportunities and minimising the threats (Vidal et al., 2011). Such project complexity needs to be managed well in order to add value to the project. The first approach to manage project complexity is to keep projects simple as suggested by Giezen (2012). The uncertainty in projects will be reduced by diminishing the project's complexity. This way it becomes easier to better predict the project and consequently better manage the project. However, reducing a project's complexity has also some disadvantages like ignorance of the project's strategic potential. Therefore, instead of focusing on the complexity itself, the alternative approach concentrates on the project management capabilities in managing project complexity.

Nowadays, a pure project management approach is no longer effective (Hertogh and Westerveld, 2010, Koppenjan et al., 2011). Smith and Irwin (2006) were one of those who questioned the ability of traditional project management approaches to effectively deal with complexity which is not rational and linear. Cooke-Davies et al. (2008) argue that a paradigm shift is required away from conventional project management, to enable the management of nowadays modern practice challenges. Conventional project management is known as a rational and linear approach (Williams, 2005) which makes it ineffective in the management of project complexity in the project lifecycle (Harvett, 2013). On top of that, most of the current project management approaches still seem to underestimate the influence of the

dynamic environment (Priemus and van Wee, 2013). This viewpoint questioned the capabilities of conventional project management approaches in managing the fundamental sources of uncertainty which asks for a complementary management approach (Atkinson et al., 2006). In contrast to the control conventional project management poses over the projects, literature suggests increasing the flexibility of project management in order to cope with complexity and uncertainty (Koppenjan et al., 2011). Kreiner (1995) mentions that flexibility is required to deal with changes and uncertainties in the changing business environment. Control implies the parameters should be fixed and stuck to, while flexibility implies accepting the required changes.

Having said so, the importance of bringing flexibility into project management to deal with project complexity and uncertainty requires much attention. Olsson (2006) states that "while flexibility was frequently needed in studied projects, it was rarely prepared for". Therefore this research aims at making the project management flexibility explicit by 1) recognizing the degree of flexibility in the practice, 2) find the practitioners perspective regarding flexibility, 3) embedding the flexibility into the practice, and 4) focusing on improvement of project performance and management of complexity by implementing the flexibility. To fulfil these four objectives, four research questions were formulated.

1. What is the status of flexibility in current practice?
2. What are the enablers of flexibility?
3. What are the practitioners perspectives regarding project management flexibility?
4. What is the contribution of flexibility on project performance?

By answering the four questions a conceptual framework is proposed in this paper. To develop the framework, four separate researches were performed as part of a PhD thesis (Jalali Sohi, 2018).

In Section 2 the literature review on project management flexibility is covered. Section 3, 4, 5, and 6 in order provide the answers to the four formulated research questions. Section 7 elaborates on the proposed flexibility framework. The discussion and conclusion are covered in Sections 8 and 9.

2. LITERATURE REVIEW: WHAT IS FLEXIBILITY IN PROJECT MANAGEMENT?

One of the early definitions of flexibility is provided by Bateson (1972). He defined flexibility as "uncommitted potentiality for change". He argues the ability to harmonize with the environmental flexibility in advanced urban civilizations which has the highest degree of flexibility in his opinion. He emphasised that the context conditions should be taken into account while talking about flexibility.

Flexibility can be defined as a competence of the project manager, as discussed by Turner (2004): *the project manager should be empowered with flexibility to deal with unforeseen circumstances as they see best, and with the owner giving guidance as to how they think the project should be best achieved*. Flexibility may be described as a way of making irreversible decisions more reversible or postponing irreversible decisions until more information is available (Olsson, 2006). This refers to the following definition of flexibility of Husby et al. as: *the capability to adjust the project to prospective consequences of uncertain circumstances within the context of the project* (Olsson, 2006). Flexibility can be related to the degree of modularity in projects while modularity refers to the possibility to divide the project into more or less independent sub-units (Olsson, 2006).

All these definitions have two main facts about flexibility in common: taking the dynamic context into account and readiness for changes. What can be concluded from these provided definitions is unanimity about 'ability to adapt to project context and to the dynamics of the environment'. This concluded commonality from the provided definitions, forms the base definition of flexibility for this research: "the ability and readiness to deal with dynamics in a project".

Apart from defining what flexibility in project management is, some scholars have looked for practices of flexibility. Sager (1990) found two main aspects of flexibility in order to prepare the management to deal with uncertainty and its effect on the project in urban planning: future choice opportunities and capacity for adjustment. He defines robustness,

resilience and stability as other related qualities to flexibility. Flexibility in the planning and implementation phase of a project may be accomplished not only by flexible decisions, but also through the possibilities for adjustments in the entire planning system: departing from plans, changing them, or side-stepping them altogether (Sager, 1990). According to Gupta and Rosenhead (1968), robustness in sequential investment decisions is defined as *Robustness of a decision or decisions must be measured in terms of the numbers of the good end-states for expected external conditions which remain as open options*. Hashimoto et al. (1982) define resilience as the quality which describes *how quickly a system is likely to recover or bounce back from failure once failure has occurred*. Stability of a plan or a project was defined as *the maximum deviation between predicted and realised value of the key variables which renders the planning product satisfactory* (Sager, 1990).

Hertogh (2014) discussed the fact that project managers should be open for opportunities, not only at the start, but also during the course of the project. This so-called opportunity framing is supposed to be a recurring, iterative process, aiming at maximum value creation. However, usually project managers stick to their scope, hence missing possible enrichment of their projects. Sager (1990) stated that keeping options open is the crucial concern, and this is what flexibility is aimed at.

Aaker and Mascarenhas (1984) argue while the intention of the control-oriented approach is reducing undesirable changes, flexibility enables incorporating required changes which might happen because of the uncertain and changing environment. Control versus flexibility approaches is what Koppenjan et al. (2011) defined as 'command-and-control' versus 'prepare-and-commit'. The difference between these two approaches lies in their attitude towards managing uncertainty and complexity. The command-and-control approach aims at eliminating the uncertainty and complexity by imposing strict planning and control over the process, while the prepare-and-commit approach aims at managing both uncertainty and complexity by close cooperation between the project actors and hence, increased flexibility.

Perminova et al. (2008) stated that reflective learning and sense-making is required in order to increase flexibility. Re-

flective learning can be done by standardisation or repetitiveness of procedures. Standardisation helps to react to possible changes by providing flexibility in choosing among a number of alternative actions. However, it is not possible to reduce all the uncertainty by standardisation. While uncertainty can be decreased to some degree, some uncertainty is wished for to grab opportunities. Evolution is tied with opportunities and the elimination of all uncertainties hinders the evolution of the project. Similarly, Collyer and Warren (2009) identified one of the management approaches in dynamic environments as 'environment manipulation: making dynamic static'. This can be done by fixing objective and design, refusing change requests, reducing or delaying adoption of new technologies or techniques and extending the life of existing systems. The approach of making dynamic static also has disadvantages like lost opportunity and productivity through delayed implementation of new approaches. On top, it is not always possible to reduce complexity or making dynamic static since we do live in a dynamic environment.

Similar to flexibility, adaptability in project management is a term emphasising the adaptation of project management to the (changing) context of projects. Giezen (2012) defines adaptability as the ability of adaptation to changes. Priemus and van Wee (2013) argue that adaptability is needed. They argue that complex projects require adaptations in their management in order to deal with threats and opportunities to overcome the internal deadlocks and external changes.

This brief literature scan suggests that in order to manage the project's complexity and dynamics an ideal project management approach should take the following into account:

- Redundancy in terms of keeping alternatives open and making a decision at the last responsible moment (Priemus and van Wee, 2013),
- Achieving reflecting learning by standardisation of process and design to the degree that fits the project's context (Perminova et al., 2008, Giezen, 2012),
- Being open to change by understanding that change is unavoidable, coping with threats and seizing opportunities (resilience) (Priemus and van Wee, 2013),
- Defining the project's scope into required functions (Koppenjan et al., 2011),

- Establishing stakeholders' close collaboration (Koppenjan et al., 2011),
- Self-steering of the complete project team (Koppenjan et al., 2011),
- Having an open attitude for information exchange (Koppenjan et al., 2011),
- Building trust among the parties involved in the project (Atkinson et al., 2006).

The aforementioned characteristics point out some features of flexibility in project management. However, flexibility is not only limited to these items.

So far the need for flexibility in project management, definition of flexibility and some recognized practices of flexibility were discussed. The next section focuses on current practice regarding flexibility in project management.

3. FLEXIBILITY IN CURRENT PRACTICE OF PROJECT MANAGEMENT: AGILE PROJECT MANAGEMENT

First step in adding flexibility to project management is the recognition of current flexible approaches. This section elaborates on the current flexible project management approaches by means of literature review and empirical study on application of such flexible approaches in practice.

Agile Project Management is the most-known flexible project management methodology. It is defined as a *style of project management that focuses on early delivery of business value, continuous improvement of the project's product and processes, scope flexibility, team input, and delivering well-tested products that reflect customer need* (Owen et al., 2006). Agile approach was developed in the software industry but many other industries, including the construction industry, have also adapted the Agile approach (Owen et al., 2006). Agile project management lets software project managers and employees adapt to changing circumstances, rather than trying to impose rigid formal controls, as in traditional linear development methods (Augustine et al., 2005). Agile core values are: *high-quality*

deliverables are a result of providing customer value, team interactions and adapting to current business circumstances (Layton, 2010). In contrast to Agile, traditional software development methodologies can be characterized as reflecting linear, sequential processes, which can be effective in developing projects with stable, known, consistent requirements (Augustine et al., 2005) which mismatches with dynamic systems. Highsmith (2002) stated that Agility is the ability to balance flexibility and stability. Agile methodologies have sought to focus on rapid iterative delivery, flexibility, and working software projects (Abrahamsson et al., 2003) mutual interactions among a project's various parts and steering the them in the direction of continuous learning and adaptation (Augustine et al., 2005). Conventional project management approaches promise predictability, stability, and high assurance which is in contrast to Agile promises being higher customer satisfaction, lower defect rates, faster development times and a solution to rapidly changing requirements (Boehm and Turner, 2003).

Since Agile is an umbrella name, in itself, cannot be seen as a tool. Therefore it is more recognized by its tools like Scrum (Agile-Methodology, 2014).

In an empirical exploratory case study research (Yin, 2002) the application of Agile project management and its tool Scrum in the context of infrastructure projects in construction industry is studied (Jalali Sohi et al., 2016). In total 9 interviews were performed, including respondent from 3 projects managed using Scrum. All interviewees were at the project level and assigned to the project in different roles including project manager, project engineer, Scrum master and Scrum coach. During the interviews several themes were covered which were extracted from the literature regarding the characteristics of Agile project management. The themes were: performance of project, value delivery, client satisfaction, project team, role of Scrum master, interaction among the parties involved in the project, reporting, project planning and management of scope changes.

The practice of Scrum versus the theory of Scrum is presented in Table 1.

Table 1. The practice of Scrum versus the theory

Explored items	Scrum based on the theory	What is happening in practice at the company (3 projects)	Aligned	Mis-aligned	Neutral
The overall success of the project		Successful from the client point of view, successful from projects teams, not successful from the company point of view.	N/A		
Time	Time is fixed.	Mostly projects delivered within time, for those that delivered with delay, it was acceptable by the client because the client was the source of delay.	x		
Cost	Maximum budget is fixed.	One of the negative aspects of Scrum within the company; mainly because of learning costs.	N/A		
Quality		Accepted by the client, delivery of products with high quality (company strategy).	N/A		
Client satisfaction	Main value driver of Scrum.	Clients were satisfied.	x		
Conditions of client satisfaction	Conditions of client satisfaction should be known and addressed explicitly in the project.	There was a set of quality criteria as client satisfaction conditions but overall there was no common sense what the client satisfaction conditions are.	x		
Team building	Scrum team should be constant /fixed and the project will be assigned to the team.	Few problems; first of all lack of capacity at the company, teams vary in size during the project, teams are not constant, in contrast with the principal team is being assigned to project.	x		
Multidisciplinary team	Team should be multidisciplinary. To some extent teams are multidisciplinary.		x		
Multitasking in team	It should be avoided.	It happens always.	x		
Integration	Working in one room rather than individually in separate offices.	Scrum teams were integrated. In case of multitasked people in the team, the level of integration decreases considerably.	x		
Exchange of information/knowledge	Working in one room rather than individually in separate offices.	Easy/doable in face to face communication.	x		
Documentation	Proper/enough documentation over too much paperwork.	Enough for the project itself but not enough as lesson learned for another project. In case of multitasked people in the team, the amount of documentation increases.	x		
Overall picture of the project	Visualising the overall project.	Scrum creates the big picture of the project. The inconsistency of the Scrum team is a problem here.	x		
Meeting	Within team	Daily stand-ups/sprints' meetings.	Different opinions. Examples are: difficult when a team member is a multitasker, waste of time, saves time according to team alignment.	x	
	With stakeholders/client	Client involvement/participation in weekly/every sprint meeting.	Not enough client involvement/ no interest from client side to participate in all meetings.	x	
Value	Definition	Value should be defined at the beginning.	No definition of value.	x	
	Tracking	Value should be traced during the project.	Since there is no value definition there won't be any tracking of value.	x	
Planning	Product backlog	Work is done in small batches which are listed in the product backlog.	Product owner defines the product backlog.	x	
	Sprints	Value orientation over process orientation; delivering something that has value for the client in 2 to 4 weeks' time.	It worked well in doing the tasks but there is doubt if Something that has value for the client delivered in each sprint.	x	

Duration of tasks	Realistic time planning by means of poker game.	Estimation of the duration of tasks (products) by poker game.	x
Reporting	Within team	More face to face, less paperwork.	Informal face to face discussion rather than official reporting, digital Scrum board which updates regularly.
	With client	Client involvement/ close cooperation with client.	Monthly report to client/ NO client involvement in the Scrum process.
Time buffers	Is needed.	Because of tight deadlines there were no planned buffers.	x
Response to scope change	Responding to change (scope change).	In contrast with contract conditions, it results in request of extra budget and time.	x
Problem solving	Problem solving should be planned/clear. Impediment resolving.	Not really planned; product owner/project manager was a source of problem solving.	x

This exploratory research revealed a number of positive outcomes by using Scrum in the management of infrastructure construction projects. The impression obtained during the interviews was that most of the practitioners who work in Scrum were generally very positive about it. In frequent occasions they expressed their positive opinion about the methodology:

- Scrum presents a very structured way of working (product backlog, daily stand-ups are some examples)
- Working together in the same room provides the team members an environment of continuous motivation and team satisfaction.
- The mix of different specialties in the Scrum teams is key in order to achieve maximizing the value of the project.
- There is a high level of intensity while working with Scrum which makes it efficient.
- Scrum reduces the amount of rework (early detection of problems).
- Working in an Agile environment does require high client participation in the project which focuses on the client satisfaction.

There was also a number of challenges faced while Scrum had been used in practice. Some aspects of Scrum that were perceived as dilemmas and that might have affected the result of the project are mentioned:

- Multitasking of team members affects the efficiency and also excess of required documentation/communication for those who cannot attend such events.

- Team members would be uncertain about the benefits of Scrum if they are asked to use it without educating them.
- There should be a balance between the amount of time spent in Scrum meetings and the intensity of the project (days per week).
- High level of commitment of the client is required while it is not in place.
- There is still no quantitative analysis done on how Scrum affects the end results of the project (cost).
- There should be a match with contract type if the project would be managed by Scrum (contract flexibility).

By reviewing all observed positive aspects and faced challenges of Scrum and also looking back at the comparisons made between theory and practice it is concluded that the application of Scrum in practice is not fully aligned with theory, but still it showed positive results in some areas: especially scheduling, interactions, and communications. In all case studies it was observed that the applied project management is a hybrid version. The Scrum projects follow Scrum on the basis of a waterfall approach.

4. WHAT ARE THE ENABLERS OF FLEXIBILITY?

Apart from emphasising the importance of flexibility in project management (Section 1) and the definition of flexibility (Section 2) it is important to know what makes project management flexible. Therefore, this section elaborates on enablers of flexibility in project management.

By doing literature review on flexibility in project management, a list of literature references which directly define or identify sources of flexibility is extracted. It was concluded that some literature only sheds light on the importance of flexibility in project management without explaining further what flexibility is (Olsson, 2006, Kreiner, 1995, Koppenjan et al., 2011). Some others define areas of flexibility (Geraldi, 2008, Osipova and Eriksson, 2013). A number of studies look into flexibility as one aspect like human resource management or scheduling among others (Kellenbrink and Helber, 2015, Gupta and Rosenhead, 1968, Gil and Tether, 2011, Chan and Chan, 2010). In total 30 enablers of flexibility

were extracted from all studied literature. In order to validate the flexibility enablers, 14 interviews with practitioners were conducted. In total, 13 out of the 14 interviewees had an engineering background, mostly in civil engineering. Half of the interviewees were project managers. The others were involved in projects as senior manager, process manager, project director or other roles. The majority of interviewees (71%) work in the construction industry. About 62% of them had more than 20 years of working experience.

The refined list of flexibility enablers after the data analysis on gathered data from the interviews is presented in Table 2.

Table 2. Flexibility enablers of project management

Category	Flexibility enablers	Main Source
What	1 Broad task definition	(Koppenjan et al., 2011)
	2 Embrace change as much as needed	(Olsson, 2006), (Priemus and van Wee, 2013)
	3 Functional-realisation based contract	(Koppenjan et al., 2011)
	4 Self-steering of the complete project team	(Koppenjan et al., 2011)
	5 Open information exchange among different groups	(Koppenjan et al., 2011)
	6 Shared interface management	(Koppenjan et al., 2011)
	7 Contingency planning	(Olsson, 2006)
	8 Seizing opportunities and coping with threats	(Blom, 2014)
	9 Trust among involved parties	(Atkinson et al., 2006)
	10 Standardise the process and design	(Giezen, 2012, Perminova et al., 2008)
	11 Visualised project planning and progress	(Beck et al., 2001)
	12 possible alternatives	(Priemus and van Wee, 2013)
	13 Network structure rather than hierarchical structure	(Beck et al., 2001)
	14 Continuous learning	(Giezen, 2012, Perminova et al., 2008)
	15 Consensus amongst team members	(Cobb, 2011)
	16 Stable teams	(Beck et al., 2001)

	17	Self-assigned individuals to tasks	(Cobb, 2011)
Who	18	Team priority over individual priority	(Beck et al., 2001)
	19	Team members as stakeholders	(Beck et al., 2001)
	20	Late locking	(Olsson, 2006) (Huchzermeier and Loch, 2001)
	21	Short feedback loops	(Cobb, 2011)
When	22	Continuous locking (iterative)	(Olsson, 2006)
	23	Iterative planning	(Cobb, 2011)
	24	Iterative delivery	(Beck et al., 2001)
Where	25	Joint project office	(Osipova and Eriksson, 2013)
	26	Have flexible desks	(Osipova and Eriksson, 2013)

5. PRACTITIONERS PERSPECTIVES ON FLEXIBLE PROJECT MANAGEMENT

After the identification of the flexibility enablers in Section 4, the next step is to identify the practitioners' perspectives regarding flexible project management using Q-methodology (Jalali Sohi et al., 2018). This methodology allows for studying topics with a subjective character. Two types of organizations were targeted in this research: client and consultancies. In total 43 practitioners (21 from client organisations and 22 from consultancies) from 6 organizations were participated in the research. The input for this step of the research was the list of 26 flexibility enablers concluded from Section 4.

The data analysis revealed 3 parallel perspectives per organisation type (client and consultancy). The first perspective appears in both organisation types named as 'Trust' which means trust and its related enablers ranked high as distinguishing statements for this group of practitioners regardless of the fact that they work for client or consultant organisation. However, also some differences were found. High-ranked and low-ranked flexibility enablers from each perspective's point of view are presented in Table 3. All team-related enablers ranked relatively low from the clients' point of view, but from the consultants' point of view some of these enablers ranked high. It can be said that the way the project team is organised seems much more impor-

tant for respondents from consultancy organisations than for the client organisations who share opinions in the 'trust' perspectives.

The second shared perspective was 'Scope flexibility by contractual flexibility'. Looking at the overall ranking of flexibility enablers of this perspective, not many differences between the client respondents and the consultant respondents in the corresponding perspectives were found.

The third perspective for both organisation types was 'Proactive management'. The enablers that contribute to a proactive approach, such as 'seizing opportunities & coping with threats', 'possible alternatives' and 'contingency planning' ranked high in this third perspective for both respondent groups. Also, some differences were found. For consultant respondents, the 'when' category of the enablers ranked higher compared to the client respondents. This suggests that these consultants favoured a more iterative approach in their scheduling. Another difference was found in the category of 'where': client respondents showed less willingness in having a joint project office.

The top-ranked enablers and also the derived perspectives for both clients and consultants are the same. Hence the general mind-set of these practitioners working for client or consultant organisations regarding flexibility in project management seems similar.

Table 3. High-ranked and low-ranked flexibility enablers from different perspectives' point of view (N=43)

Perspectives			
	Trust	Scope flexibility by contractual flexibility	Proactive management
Clients organisations	High-ranked flexibility enablers	<ul style="list-style-type: none"> • Trust • High-ranked flexibility enablers • Short feedback loops • Continuous locking • Seizing opportunities and coping with threats • Continuous learning 	<ul style="list-style-type: none"> • Broad task definition • Functional-realisation based contract • Shared interface management • Visualised planning and progress • Seizing opportunities and coping with threats
	Low-ranked flexibility enablers	<ul style="list-style-type: none"> • Standardised process and design • Self-steering team • Consensus among team members • Late locking • Self-assigned individuals to tasks • Broad task definition • Flexible desks • Iterative delivery • Consider team members as important stakeholders 	<ul style="list-style-type: none"> • Iterative delivery • Stable teams • Continuous locking • Flexible desks • Contingency planning • Standardisation of process and design • Self-steering team
Consultant organisations	High-ranked flexibility enablers	<ul style="list-style-type: none"> • Trust • Short feedback loops • Self-steering team • Consider team members as important stakeholders • Seizing opportunities and coping with threats • Visualised planning and progress • Self-assigned individuals to tasks 	<ul style="list-style-type: none"> • Embrace change • Broad task definition • Functional-realisation based contract • Possible alternatives • Self-steering team
	Low-ranked flexibility enablers	<ul style="list-style-type: none"> • Broad task definition • Late locking • Contingency planning • Possible alternatives • Network structure • Functional-realisation based contract 	<ul style="list-style-type: none"> • Consensus among team members • Iterative delivery • Stable teams • Visualised planning and progress • Contingency planning

6. THE CONTRIBUTION OF FLEXIBILITY TO PROJECT PERFORMANCE

It was evident from the literature that conventional project management needs to gain flexibility to deal with dynamics of nowadays projects. Those dynamics are known as sources of uncertainty and complexity. The effect of such management flexibility on project performance in the domain of infrastructure construction projects has not been studied empirically. Therefore this section elaborates on the effect of project management flexibility on project performance. Adding flexibility into the practice of project management is assumed to improve project performance by better dealing with project complexity. To study the effect of flexibility on project performance, a survey study was performed. By doing the statistical analysis using SEM-PLS (Structural Equation Modelling-Partial least Square) method on data gathered from 111 surveys the 5 hypotheses regarding the direct effect of five areas of flexibility on project performance are tested. An overview of hypotheses is provided in Table 4.

7. PROPOSED FRAMEWORK

Studying the notion of flexibility in project management, its definition and enablers, the practitioners' perspectives regarding flexibility, and the contribution of flexibility to project performance lead us to the development of a framework to embed the flexibility into practice. The so-called 'Flexible project management framework' (Figure 1) answers the four research questions formulated in Section 1. The framework includes four steps that logically follow each other in an iterative way. Here the four steps of the framework are explained by linking each to the section in this paper.

Step 1: Insight

As the name suggests, the goal of this step is to create insight about the project complexity and applied project management approaches in current practice. Project complexity is important to be understood and investigated to be managed well. It was studied in Section 2 the current prac-

Table 4. hypotheses regarding the effect of project management flexibility on project performance

#	Hypothesis	Results of testing
1	Project management flexibility in terms of project scoping and contracting (what) has a positive effect on project performance.	Rejected
2	Project management flexibility in terms of process (how) has a positive effect on project performance.	Supported
3	Project management flexibility in terms of project team organisation (who) has a positive effect on project performance.	Rejected
4	Project management flexibility in terms of scheduling the project and task delivery (when) has a positive effect on project performance.	Rejected
5	Project management flexibility in terms of location of team (where) has a positive effect on project performance.	Rejected

Among the five hypotheses regarding the existence of positive relationships between project management flexibility and project performance, only one was supported: flexibility of 'how' has a significant positive effect on project performance. The significant positive relationship here means that the higher the flexibility of 'how', the better the project performance.

practice has applied Agile Project Management as the existing flexible project management approach. However, the application of such methodology and its tools like Scrum is not fully aligned with literature. Whether it should be fully aligned with theory or not depends on the added value of such methodology to the practice. Therefore it is suggested to customize the application of Agile to be fitted to the requirements of the practice.

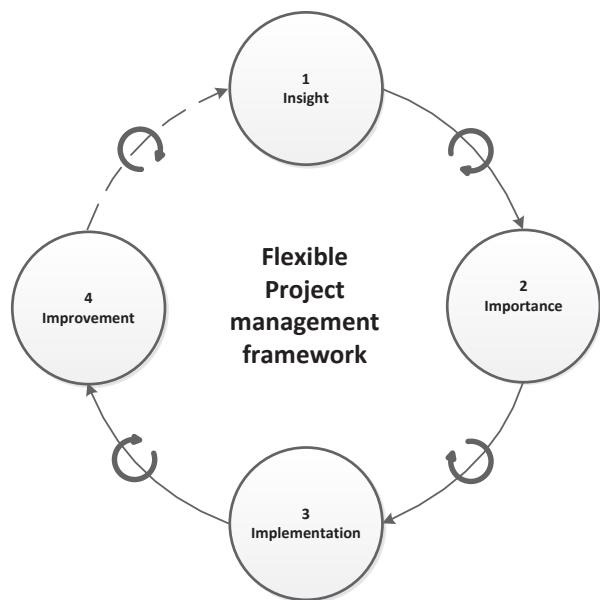


Figure 1. Flexible project management framework (main steps)

Also the two main extremes are recognised in project management: a pure waterfall approach versus a pure Agile approach. Practitioners can apply either the pure approaches or any hybrid version. Whatever approach is applied, it is important to be aware of where the current approach fits in the spectrum from pure waterfall to pure Agile.

Step 2: Importance

This step is about investigating the practitioners' perspectives regarding flexible project management as it was discussed in Section 5. Based on what practitioners find important to make project management more flexible, three distinct perspectives were derived: flexibility by 'Trust', 'Scope flexibility by contractual flexibility' and flexibility by 'Proactive management'. Each perspective gives higher priority to certain flexibility enablers. One of the most outstanding results of this study was that the perspectives of practitioners who work as clients were the same as perspectives of practitioners who work at engineering consultancy organisations. In this step of the framework, it is suggested to understand which of these perspectives exist in the project team in order to facilitate collaboration.

Different perspectives might co-exist in any project team and perspectives might change over time. The goal is to understand which perspectives exist (make it explicit) and

what is felt important for the project. While the first step in the framework was about creating insight in the awareness of the applied project management approach, the second step is about creating awareness of the practitioners' mind-sets.

Step 3: Implementation

By getting insight in the awareness of what is in place for the project management and what the mind-sets of people are, the foundation for making project management flexible is ready, but this needs to be implemented. Section 3 presented 26 enablers of flexibility which contribute to five areas of flexibility (what, how, who, when and where). The third step of the framework is about applying those flexibility enablers into practice.

The implementation of enablers belongs to the flexibility of 'what', is about the scoping of the project: defining the project's scope into broad tasks rather than detailed work packages and based on the required function. Delivering tasks not necessarily results in delivering the function. The emphasis should be put on the function in order to deliver the value.

The implementation of enablers belonging to the flexibility of 'how': decisions should be made interactively with the close involvement of stakeholders, information exchange should be open between the parties involved in the project and also information sharing should be enhanced, alternatives should be evaluated in terms of their relevance and the most relevant ones need to be kept on board, a proactive approach regarding opportunities and threats is required and also considering contingencies helps to deal with unforeseen circumstances. Moreover, the project team is suggested to be self-steered rather than being steered only by a project manager, managing interfaces as a shared task rather than being done by a project manager, building and maintaining trust among the involved parties, establishing management support from top management in the organisation and reducing the hierarchy in the organisation to form a more flat type of project organisation.

The implementation of enablers belongs to the flexibility of 'who', is about how to organise project team in terms of collaboration and structure. In terms of team collaboration: establishing the mind-set of team priority over individu-

al priority and valuing team members by considering them as valued stakeholders in the team. In terms of team structure: delegating responsibilities to team members, reaching consensus in key decisions among the team members and establishing stable team rather than building the team per project.

The implementation of enablers belonging to the flexibility of 'when', is about having short feedback loops and locking (fixing decisions) continuously in an iterative way.

The implementation of enablers belonging to the flexibility of 'where', is about establishing a joint project office (either physically or virtually) for the project team.

Step 4: Improvement

This step aims at improving project performance by application of certain flexibility enablers. In section 6 it was discussed that flexibility of 'how' has a positive significant effect on project performance. It means that if 'how' flexibility is applied in practice, the performance of the project will improve significantly. This area of flexibility includes: interactive decision making, close involvement of stakeholders, open information exchange among different groups, contingency planning, seizing opportunities and coping with threats, visualised project planning and progress, self-steering of the complete project team, shared interface management, trust among involved parties, standardise the process and design, possible alternatives, network structure rather than hierarchical structure, continuous learning and management support.

Step 2 was about practitioners' perspectives. What do these perspectives mean for step 4? The three distinct perspectives (trust, scope flexibility and proactive management) all include some high ranked enablers from the 'how' flexibility enablers. For example, in the perspective of 'trust' from the clients' point of view, 'shared interface management', 'open information exchange', 'visualised planning and progress', 'seizing opportunities and coping with threats', and 'possible alternatives' were ranked high. In the perspective of 'scope flexibility by contractual flexibility' from consultants' point of view, 'seizing opportunities and coping with threats', 'possible alternatives' and 'open information exchange' are three examples of flexibility enablers which ranked high. In the per-

spective of 'proactive management' from the clients' point of view, 'seizing opportunities and coping with threats', 'trust', 'self-steering of team' and 'possible alternatives' are ranked high. It can be seen that the same enablers like 'trust' ranked high in different perspectives.

So improving project performance seems possible regardless of the adopted perspective in step 2. Understanding the different perspectives among team members for any project is recommended in order to prioritize the application of flexibility enablers (Step 2 of the framework).

It was mentioned that the framework has an iterative character. This appears not only in the sequence of the steps but also backward moves are possible. The iterative character of the framework helps continuous improvement in the practice as it is indicated in the literature about Agile project management (Augustine et al., 2005, Cobb, 2011). Therefore the flexibility framework developed in this research, follows an iterative process, in a circular manner. The framework includes multiple and reverse arrows which acknowledge the iteration in any direction depending on the situational circumstances and required improvement actions.

The full proposed framework is presented in Figure 2.

8. DISCUSSION

Answering the four research sub-questions on current flexible project management approaches, the enablers of flexibility, the practitioners' perspectives and the contribution of flexibility on project performance resulted in a framework of flexibility.

Terryn et al. (2016) stated that developments in terms of projects become increasingly complex which makes the future of such developments hardly predictable. They argue that the existing theories and frameworks for evaluation and planning of such complex developments do not take into account the complexity and uncertainty. According to them, these frameworks have linear or circular logic, focused on several feedback loops and assumed causal links in organization, planning process and performance. What they propose as a solution is a situational approach based on the nature of planning issues and playing field. They believe where the playing field is highly dynamic, undefined and

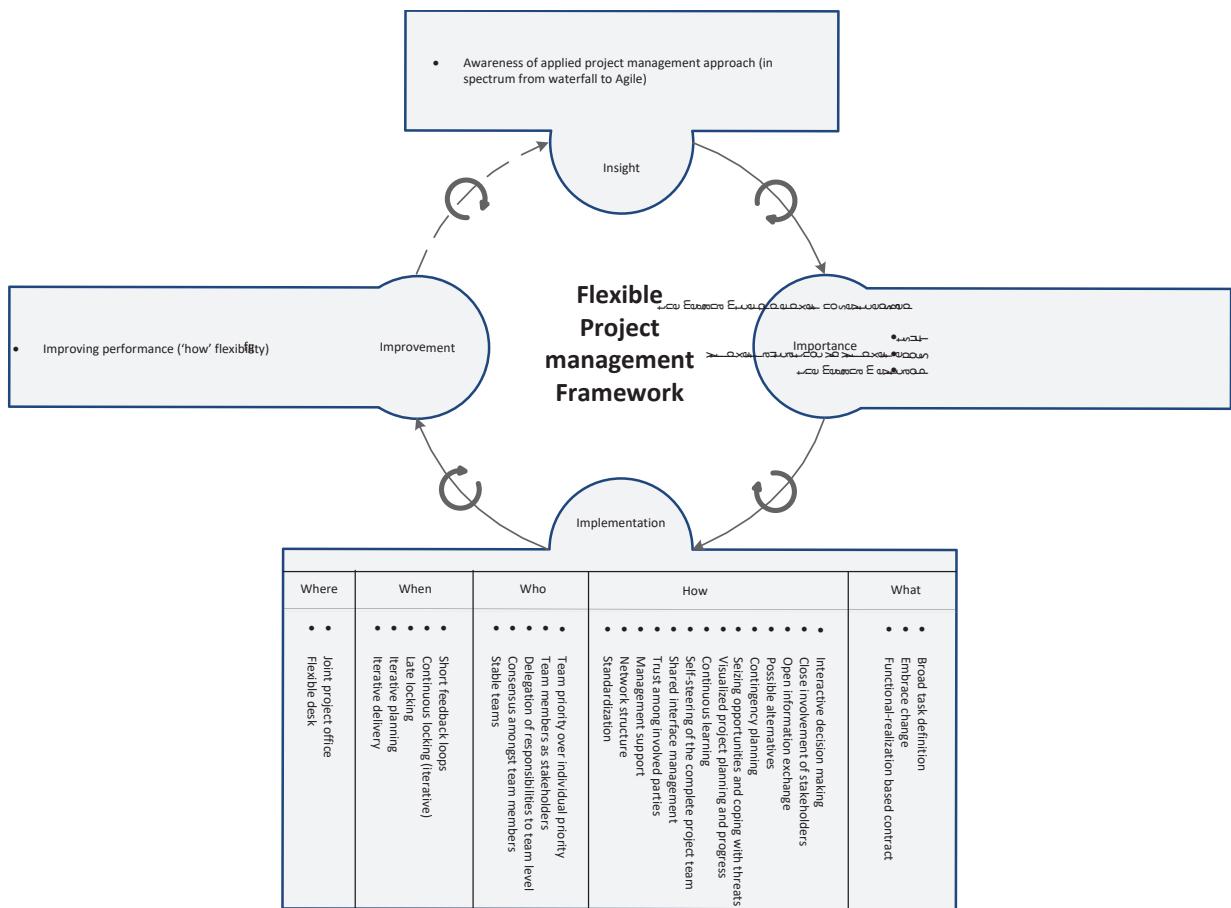


Figure 2. Flexible project management framework

volatile, the developments needs to be highly open, flexible and innovative (Terryn et al., 2016, Boussauw and Boelens, 2015). In such conditions a co-evolutionary approach would be required. This, however, is not conflicting with the flexibility framework as presented in Figure 1.

In our research, the idea of flexibility in project management acknowledges the importance of iterative processes for the achievement of improvements based on short feedback loops. Therefore the flexibility framework developed in this research, follows an iterative process, in a circular manner. The framework includes multiple and reverse arrows which acknowledge the iteration in any direction depending on the situational circumstances and required improvement actions.

The proposed flexibility framework covered both the people side of the projects as well as the process of project management into account. The people side is mainly highlighted

on step 2 in which practitioners' perspectives are taken into considerations.

Although the role of trust has been studied in different aspects of project management such as contracting (Benítez-Ávila et al., 2018, Chow et al., 2012), trust and control (Kalkman and de Waard, 2017) and other soft aspects of project management (Ping et al., 2016, Rezvani et al., 2016, Ning, 2017), the role of trust in flexibility of project management is not given any attention so far. In this research it revealed that 'trust' is an enabler of flexibility in project management (Section 3). Trust contributes to flexibility of 'how'. All the interviewees who participated in validating the flexibility enablers unanimously agreed that 'trust' is an enabler of flexibility.

The overall ranking of flexibility enablers was the other outcome of the exploratory research on practitioners perspec-

tives (Section 5). The three top-ranked enablers from the clients' point of view were 'embrace change', 'seizing opportunities and coping with threats' and 'trust'. The three top-ranked flexibility enablers from consultants' point of view were the same ones as the client respondents' point of view, albeit in a different order: 'embrace change', 'trust' and 'seizing opportunities and coping with threats'. This research showed that 'trust' is among the top-three flexibility enablers by both client and consultancy organizations. Moreover, it appeared to be a perspective by a group of practitioners pinpointing the importance of 'trust' in flexible project management.

Next, the significant positive contribution of flexibility of 'how' to project performance was confirmed in Section 6. Needless to say that flexibility of 'how' includes 'trust' as an enabler. This indicates the positive effect of trust as a flexibility enabler to project performance.

Given this study, it can be said that 'trust' has an important role in project management flexibility in different dimensions.

8.1 Scientific contribution and managerial implications

It is recognised that project complexity is increasing (Bosch-Rekeldt, 2011, Bakhshi et al., 2016). Different management approaches were suggested for managing projects based on their complexity (Hertogh and Westerveld, 2010). These management approaches can be categorized into two main management streams: a mechanistic stream and an organic stream. Some other scholars stated that pure approaches, either mechanistic or organic, are not performing well (Geraldi, 2008, Huchzermeier and Loch, 2001, Koppenjan et al., 2011, Kreiner, 1995, Olsson, 2006, Osipova and Eriksson, 2013, Wysocki, 2007). Therefore a fine balance in the spectrum of management approaches is required (Hertogh et al., 2008). Such balance is referred to as flexibility in the literature (Geraldi, 2008, Osipova and Eriksson, 2013). While literature acknowledges the need for flexibility in project management, it hardly identifies the enablers of flexibility and its effect on project performance. This research bridges this gap in the literature by proposing a flexibility framework highlighting the role of 'trust' in the concept of flexibility.

For the managerial implications it is suggested to practitioners to carefully pay attention to (no specific order):

- Finding the balance between Agile and waterfall management approaches based on the specific project context. By understanding how complex the project is, the practitioners can choose the right management approach. This management approach can be a hybrid version of waterfall management and Agile project management. For example, by planning the project into iterations (short or long), organising co-located teams, focusing on value delivery rather than task delivery and establishing stable teams, they can become more Agile.
- Improving the practice of Agile (Scrum) based on the observed benefits such as structure of work, team spirit, interchange of knowledge, rework reduction and challenges like multitasking and intensity of scrum meetings.
- Recognition of different practitioners' perspectives ('trust', 'scope flexibility by contractual flexibility' and 'proactive management') about making project management flexible and giving priority to the one (including its high-ranked enablers) which fits the project context based on its requirements and complexity.
- Making project management flexible by applying flexibility enablers. In general making project management flexible can be done by enabling the flexibility in terms of the scope of the project (what), in terms of project processes (how), the project team (who), project scheduling (when) and the location the project team is organised (where).
- Focusing on enablers from 'how' flexibility to improve project performance.

8.2 Limitations and recommendations for further research

The applicability of the proposed framework is the other research limitation since it was not investigated. All the stages of the framework were confirmed in different steps of the research either statistically or by doing qualitative analysis, however, the applicability of the overall proposed framework requires further research.

The newness of the studied topic of flexibility in project management leaves room for further research, even after this study. This is recognised in a few directions: the application of Agile, flexible project management and management of project complexity. Since this paper proposed a conceptual framework for flexibility in project management it is recommended to study the applicability of the proposed framework in the practice and its further development.

9. CONCLUSION

Project management is aimed at supporting practitioners to increase the probability of the successful delivery of their projects in a way stakeholders appreciate and include both hard factors and soft factors of project management. It is developed in the 1950s and is maturing day after day but still has deficiencies which arise as consequences of environmental changes and developments. Scientists' and practitioners' attention is drawn to study and understand project complexity in order to be able to manage it. Conventional project management seems no longer effective in managing project complexity and uncertainty. Therefore to make project management capable of managing project dynamics it is suggested to increase its flexibility. The objective of this conceptual paper was to propose a practical framework to enhance the embedment of flexibility into practice of project management. By answering four research sub-questions a flexibility framework was proposed. Four stages of the framework are: insight, importance, implementation and improvement. The first stage's goal is to get an insight into

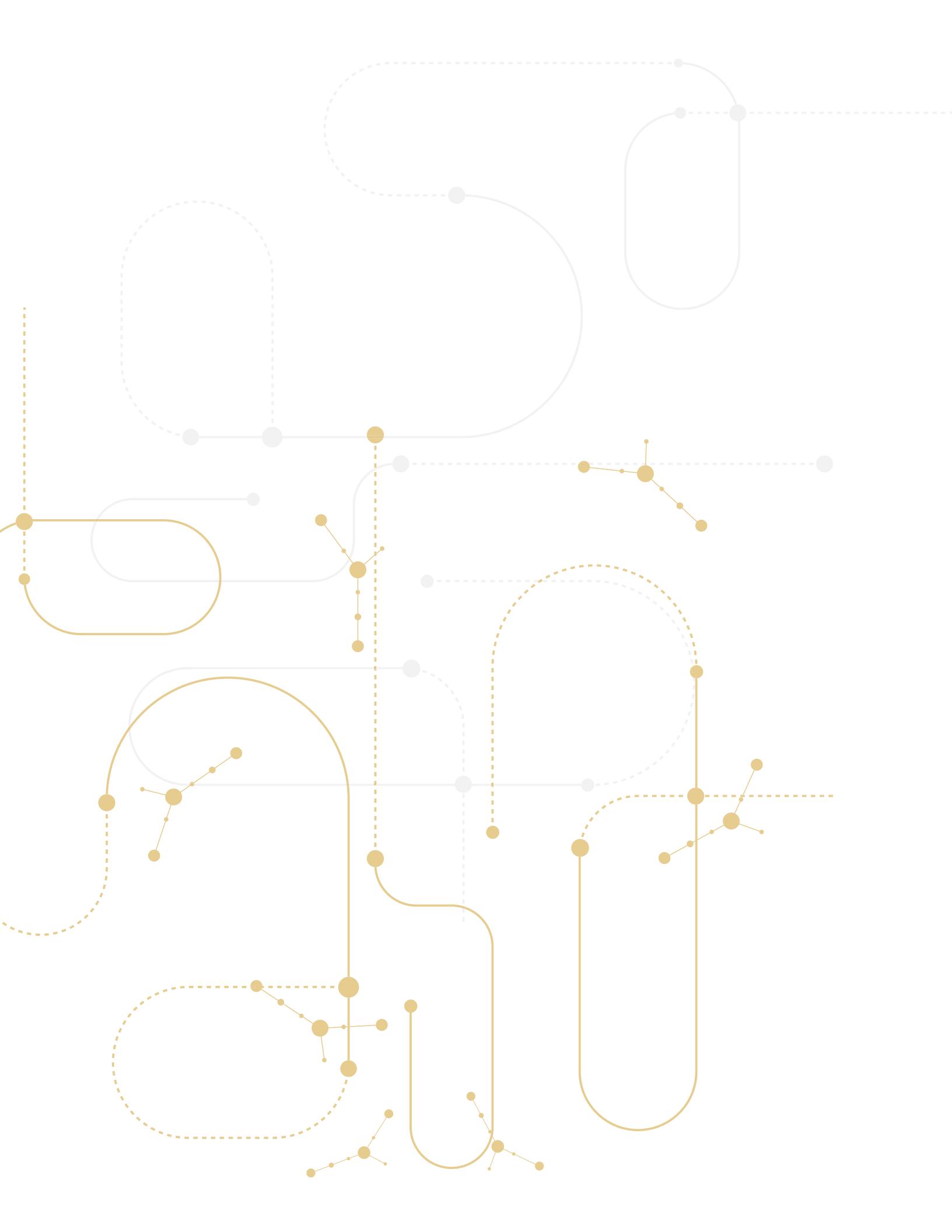
the current situation in terms of the applied project management approach. The idea is to understand if any flexible approach (like Agile project management) is being applied or not. In this stage, the preconditions for making project management flexible should be explored. The second stage is understanding what is important for flexible project management from practitioners' point of view (creating awareness for the different perspectives). The third stage is making project management flexible. The input of this stage is the list of 26 verified flexibility enablers in five areas of flexibility (what, how, who, where, and when). The fourth stage is narrowing down the flexibility enablers to those that improve project performance. It was proven that flexibility of 'how' among all five areas of flexibility had a positive significant relationship with project performance. At this stage, it is recommended to apply the enablers from the 'how' flexibility.

Talking about flexibility, the role of 'trust' is undeniable. 'Trust' appear to an enabler of flexibility in project management. Exploring the practitioners' perspectives regarding flexibility revealed that 'trust' exist as a perspective among the practitioners. This means that a group practitioners value 'trust' and its related components like open information exchange and self-steering team ranked high from this group practitioners. Studying the effect of flexibility on project performance, 'it became apparent that 'trust' among other flexibility enablers of 'how' contribute positively to project performance. Therefore, it can be said that 'trust' plays a significant role in the concept of flexibility in project management.

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Explicit and Implicit Relationship Between Stakeholder Management and Trust Concepts: Construction Project Management Perspective

ABSTRACT

Major and megaprojects have great impact on people, consumes large amount of resources and drives attention of wider communities. Project stakeholder management (SM) and trust both lead to better stakeholder relations and ultimately better project performance. Regardless of trust and SM shared goals, evidences of connection between these concepts is weak which can be considered as a research gap. In order to address question of relationship between two concepts we undertook systematic literature review and identified papers which explicitly links those two concepts. Additionally, we explored SM and trust related papers dealing with stakeholder relationship management and those dealing with project context in which relationships takes place and extracted papers which implicitly relates these two concepts. Theoretical contributions are made for both related concepts as key implication of their relationship can be taken as a new point of departure for trust and SM. Relationship management could be positioned within stakeholder engagement processes and trust-measuring system could be part of this relationship management aiming to improve adequacy of SM related actions. In case of major and more complex projects procurement system could be assessed based on alignment of stakeholder needs and concerns along with assessment of trust-building potential which that procurement system provides. This paper examines dominant strategy context of stakeholder management from construction project management perspective. In order to address this research limitation future research could include social and environment context of PM and other research areas to further advance PM theory and practice.

Keywords: Stakeholder Management; Trust; Concept; Explicit Relationship; Implicit Relationship

1. INTRODUCTION

Projects are done by people and for people (i.e stakeholders) and thus management of people e.g. project stakeholders is essential for project management (Roeder, 2013). This is corroborated by increasing significance of stakeholder theory in project management field where in 2009, stakeholder related articles represented 17 % of overall PM literature (Littau et al., 2010). Examining industry context of SM literature Littau et al (2010) and Kwak and Anbarri (2009) points out that construction industry is the dominant industry sector. Mega construction projects often involve various stakeholders which have different levels and types of interests in the project (Mok et al. 2015) with a great chance of stakeholders having conflicting views and expectation from project (Bal et al., 2013). Failing to meet stakeholder expectations could lead to project opposition which endangers project progress and project success (Ward and Chapman, 2008). Thus the main goal of SM is to involve and engage project stakeholders properly by forming a trustful relationship with them (Bourne and Walker, 2005). Stakeholder management is relatively mature concept which became 10th knowledge area in best practice standard PMBOK (PMI, 2013). Key SM related research topics of stakeholder identification, analysis and engagement became main SM processes but nevertheless there are ongoing researches in SM tools, techniques and models (Rowlinson and Cheung, 2008; Yang and Shen, 2015; Oppong, Chan and Dansoh,

2017) which are still divergent. Project managers are still unfamiliar or confused on how and when to implement SM methods (Yang et al., 2018) pointing out that there is room for improvement in SM field.

Trust has become a key research area within construction and project management but it is still complex and multifaceted issue (McDermott et al., 2005). Karlsen et al. (2008) showed in empirical research on large construction project that trust between project stakeholders plays an important role in terms of building well-functioning relationships among project stakeholders and Pinto et al. (2009) proved influence of trust on better project performance. Trust considers willingness to rely on others actions (be dependent on them) and it affects the willingness of project stakeholder to co-operate with others (McDermott et al., 2005), so in order to prevent conflicts and exploit collaboration among project stakeholders it is essential to form a trustful relationship with them (Pinto et al. 2009). Trust is seen as a constituent element of a stakeholder relationship (McDermott et al., 2005) and act as a facilitator in stakeholder relations (Francisco de Oliveira and Rabechini, 2019) which is essential in large projects in which many of the stakeholder relationships are not governed by contracts. Trust is elusive and complex concept (Khalfan, McDermott and Swan, 2007) with some related topics of inter-personal and intra-firm trust being largely under-researched (Ceric, 2015a). Trust models, trust building methods aiming to improve stakeholder collaboration and novel project delivery methods (i.e. partnering) are main research streams related to trust concept (Gad and Shane, 2014) but these areas are quite immature with no evidence of wide spread and stable PM tools and methods.

Both concepts and their related PM methods have the same goal of establishing positive and trustful stakeholder relationships and creating the project context which considers various stakeholder interests and facilitates stakeholder collaboration. Furthermore, both concepts are very important for project management which is corroborated with vast body of literature dealing with each concept separately. Regardless of trust and SM shared goals evidences of connection between stakeholder management and trust concept are weak which is a research gap that needs to be addressed. Thus, research question of this paper is aiming to answer how are concepts of stakeholder management and trust explicitly and implicitly interrelated in construction project management literature and what are implications of

this relation? Framing the relationship between two close PM fields is proven to be beneficial to PM theory and practice. Relating these two concepts could bring benefits to stakeholder management and trust building processes by adding new insights and related PM aspects in existing methods (i.e adding trust-building mechanisms in existing SM models). Novel insights in relationship of SM and Trust concepts can serve as a new theoretical starting point for researches in each field separately as well as for possible future integration of these two PM fields.

2. LITERATURE REVIEW

2.1 Stakeholder management concept and its key aspects for (construction) project management

The stakeholder theory concept was initially developed in the US in the 1960s in academic research where stakeholders were referred to as "those groups without whom support the organisation would stop existing" which was opposite of the dominant point of view that only shareholder must be taken into account (Mitchell et al., 1997; Stoney and Win-stanley, 2001). Although, definition of stakeholder evolved through years, Freeman's (1984) definition that "stakeholders are any group or individual who can affect or is affected by the achievement of the (project) organization's objectives" remains actual with some scholars slightly adjusting it. Twenty-five years after Freeman (1984) introduced stakeholder theory, Littau et al. (2010) systematically examined development of this theory in PM journals in this 25 year period (1984-2009) and reported on its significance for PM research field. From four detected context in which stakeholder theory related work is classified, evaluation context (e.g. project success) and strategy context (e.g. SM related processes and activities) are dominant (Littau et al., 2010) while social and environmental context is under-researched (Eskerod et al. 2015). In recent years evaluation of project success shifted to more soft perspective, especially in major and megaprojects, and new success model elaborates that project can be declared successful only if stakeholders needs and expectations are met (Turner and Zolin, 2012). On the other side mainstream stakeholder management is seen through major SM processes i.e stakeholder analysis and engagement (Yang, et al., 2011a; Francisco de Oliveira

and Rabechini, 2019) and related activities. Project stakeholders affect project management processes and it is important to properly identify them and execute a rigorous stakeholder management processes (Olander, 2007) which Altonen and Sivonen (2009) considers an important feature of successful project. To enable rigorous SM processes critical success factor (CSF) related to SM was examined which resulted with development of SM management models comprising these CSF (Yang and Shen, 2015; Oppong et al, 2017). Bourne and Walker (2005) elaborates stakeholder management as a task which is specific to context and that strategies and methods applied should reflect this context. Chinyio and Olomolaiye (2010) are in line with Bourne and Walker (2008) describing that although the principles of SM can be adopted regardless of industry there is a need for empirical research in the construction industry.

2.1.1. Micro-management perspective of Stakeholder management in construction projects

Beside aforementioned two major processes of stakeholder analysis and stakeholder engagement in literature one can find many other classifications such as Karlsen (2002) seven process of SM and Bourne and Walker (2008) five processes described through Stakeholder circle methodology. Certain stakeholder management processes can be found in most classification and Yang and Shen (2015) presented four in their framework of SM in construction projects; stakeholder identification, stakeholder assessment, decision-making strategies (about stakeholder engagement) and action and evaluation (of stakeholder engagement). Stakeholder assessment is more often referred to in literature as stakeholder analysis (Mok et al, 2015; Oppong et al., 2017). Numerous models, tools and techniques can be found in literature which directly relates to SM processes. For stakeholder classification and identification there are two-classes such as model of primary and secondary stakeholder (Cleland and Ireland, 2002) or two level model of Winch (2010) developed for construction context with each class having two subclasses, and three classes-model (Chinyio and Olomolaiye, 2010; Francisco de Oliveira and Rabechini, 2019). Regarding stakeholder analysis and assessment there is power-interest matrix (Olander and Landin, 2005), power-interest-attitude matrix (Burcar Duno-vic et al., 2015), power-predictability matrix (Newcombe,

2003), stakeholder circle with attributes of power, urgency and proximity (Bourne and Walker, 2005) and many other. Decision making of stakeholder engagement is often built on various engagement profiles (Walker et al, 2008; Yang and Shen, 2015) and strategies (Aaltonen et al., 2008; Aaltonen and Sivonen, 2009) and monitoring and control can be reported in project documents. Yang and Shen (2015) framework form a loop of stakeholder management activities, which indicates that for best results the activities should be carried out iteratively during the overall project process. Yang et al (2011) listed thirty operational approaches on SM in construction projects showing that there are varieties of options on how to perform SM. One of the crucial aspect of stakeholder analysis is to develop the priority list of stakeholder based on their characteristics, mainly on their level of influence on the project, (Olander, 2007; Nguyen et al., 2009; Yang and Shen, 2015) which should enable proper engagement and management of stakeholder during the project lifecycle.

2.1.2. Importance of stakeholder management for mega (construction) projects

A megaproject is characterized by magnified cost, extreme complexity, increased risk and high visibility with a significant impact on the community (Yang et al., 2018) and Ward and Chapman (2008) pointed out that stakeholders are a main source of uncertainty in large construction projects leading to increased stakeholder-related risks. For more complex, major and mega construction projects (MCP), management of stakeholders is more significant than in smaller projects because there is a greater chance that multiple stakeholder with multiple views and conflicting interests will appear. Concerns of those stakeholders must be properly managed otherwise delivery of the project is jeopardized (Yang and Shen, 2015; Yang et al., 2018). Mok et al (2015) analysed literature on SM in MCP and provided future directions on under researched SM aspects such as stakeholder analysis method "social network analysis" (SNA) which would improve understanding of stakeholder interrelations. Project managers of several MCP (Park et al., 2017; Yang et al., 2018) showed acknowledgment of explored method but stated that it requires time consuming information collection process and social network specialists which they considered substantial barrier to SNA adoption. Public engagement, which serves as a means to safeguard public interest is particularly important in MCP (Mok et al., 2015) and involvement of numer-

ous external stakeholders which are (greatly) affected by the project, is acknowledged as one of the most important aspects of SM of MCP (Park et al., 2017; Yang et al., 2018) which adds complexity layer and differentiate them from smaller size and less complex projects. Nevertheless, very experienced project managers of MCP in Australia reported usage of basic stakeholder analysis methods (i.e stakeholder roles, power-interest matrix) or slightly more advanced like snowball sampling in order to get a clearer picture of project stakeholders (Yang et al., 2018). Regarding stakeholder engagement all PM's considered this issue very important and engaged stakeholders at the early stages of a project through public presentation, web-based tools, and regular public meetings which is considered as progress from traditional face-to-face meetings (Yang et al., 2018). Discrepancies between advanced SM methods developed for MCP and basic SM methods used in this type of project is obvious. Regardless of some differences between SM for less complex projects vs major and mega projects, large body of literature on SM in general was validated on major or megaprojects (Olander and Landin, 2005; Bourne and Walker, 2006; Olander, 2007; Nguyen et al., 2009) resulting with significantly overlap of regular (Yang et al., 2011) and MCP stakeholder management literature (Mok, Shen and Yang, 2015). Beside few aspects of SM which are tailored for more complex major and megaprojects and greater emphasis on public and external stakeholder management significant differences of SM of MCP vs SM in general are not found in literature even though this could change in future. Stakeholder management is well established concept as it can be seen from stakeholder management processes that are quite agreed on in literature and the fact that it was recognized in PMBOK as tenth knowledge area (Project Management Institute, 2013) with four SM related processes.

2.2. Trust concept and its key aspects for (construction) project management

Pinto et al. (2009) identify the human dimension of project management (trust, cohesiveness, communication, etc.) to be the single most important determinant of project success. Trust is considered as a complex concept that can have a variety of meanings depending on context and actors in relationship (Kadefors, 2004). Trust can be observed as exogenous, independent variable, i.e affecting project success, and as a result of planned activities, i.e trust-building mechanisms (Rousseau et al., 1998; Wong et al., 2008).

Trust is reasonably argued to have a strong positive influence on the strength of inter-organizational relationships which is essential for any type of construction project delivery strategy, especially EPC and partnering (Lau and Rowlinson, 2009; Pinto et al., 2009; Shen et al., 2017). Trust is a key in building a good quality relationships between project stakeholders (Karlsen et al., 2008). The issue of trust has become a significant barrier to the development of the construction industry and thus has attracted an interest of both academia and industry (McDermott et al., 2005; Wu et al., 2017). In temporary organizations trust emergence is aggravated by the fact that there is simply not enough time to develop trust (Wu et al., 2017). Nevertheless, trust is particularly important in temporary project teams in the construction industry because development of a new building involves complex working relationships and interrelations between different profession and trust is proven to enhance collaborative behaviour in project team (Buvik and Rolfsen, 2015). Beside obvious effect on inter and intra-organizational relationship, trust can contribute to time savings in a project, and enhance stakeholder motivation for direct speech and information sharing (Karlsen et al., 2008). Trust is also observed as a one of the most important risk-minimization strategy in construction project before contract is signed (Ceric, 2015b). Furthermore, interpersonal trust is most important strategy after contract is signed because it shapes key relationship between owner and contractor project's manager (two agents of principals) which is not governed by contract (Ceric, 2015b).

2.2.1. Micro-management perspective of Trust in construction projects

Trust have big influence on the project management process (Gad and Shane, 2014). It is well proven that trust facilitates collaborative mood and cooperation in project teams (McDermott et al., 2005; Lau and Rowlinson, 2009; Jiang et al., 2016). Although, it is not the same thing because cooperation may simply be contractual in nature and based on mutual economic incentive or coercive measures (Pinto et al., 2009). McDermott et al. (2005) and Ceric (2015) highlighted the importance of key relationship (owner-contractor) to trust and to the success of a project which is corroborated by many articles dealing with owner-contractor relationship (Kadefors, 2004; Pinto et al., 2009). Trust is seen as risk management strategy reducing the need of expensive control system which can hamper trust development.

ment (Khalfan et al., 2007) while Pinto et al (2009) claims that control is not opposition to trust rather a necessary complementary mean of governance. Some scholars attempts to define antecedents of trust (Jiang et al., 2016) and trust-building mechanisms (Chow et al., 2012) in order to explain how to gain and improve trust but there are different views about operationalization of trust. There are various trust models and trust classifications representing three key trust constructs (Kadefors, 2004; Wong et al., 2008; Pinto et al., 2009) which Pinto et al (2009) reduced three construct to two because their study did not statistically differentiate between intuitive and integrity form of trust. Lately there are models classifying trust with two constructs (Jiang et al., 2016; Zhang et al., 2016) with attempt to describe its positive influence of dispute resolution and project success. There are many scholars pointing on partnering as a delivery method which should reduce conflicts (Kadefors et al., 2007; Laan et al., 2011) but Lau and Rowlinson (2009) examined trust in both partnering and non-partnering projects and non-partnering project had highest trust level showing that partnering doesn't necessarily mean more trust in project team.

2.2.2. Importance of trust for mega (construction) projects

Literature on mega construction projects (MCP) is limited given the fact that emergence of this field came in early 2000 (Hu et al., 2013) and this is especially case with literature on inter-organizational trust in context of MCP (Li et al., 2018). There is a great need for development of trust concept in MCP because network of project stakeholders is much more complex meaning that there are number of stakeholder relation not covered by contracts (Ceric and Sertic, 2019). Mainstream of trust concept in MCP is similar to one elaborated for trust in general but role that trust plays in facilitating collaboration, reducing opportunism and increasing cost efficiencies is emphasized (Li et al., 2018). Li et al (2018) investigated role of relational and contractual governance and their main theoretical contribution was that trust plays key role in relational governance which expands understanding of relational governance theory in MCP. Construction of major public infrastructure is a notorious cauldron for conflict increasing the need of partnering arrangements which became common in US (Anderson and Polkinghorn, 2008). Based on lessons learned and conveyed by project managers key aspect of leadership in

MCP was establish and maintain public trust. Ceric and Sertic (2019) examined trust related papers in EPOC society and reported on importance of governance and complexity concept in relation to trust concept pointing on their further development. Cooperation and collaboration in project team, conflict and dispute resolution and risk minimization present main streams of trust concepts in MCP.

2.3. Intertwined concepts of Stakeholder management and Trust

As it can be seen from literature review these two distinctive concepts are broad knowledge areas elaborating various macro and micro project management aspects. Both fields have its place in (mega) construction project management discipline and related research topics. Stakeholder management is more mature concept having firm ground in main SM processes (strategy context) with clear goal of achieving stakeholder satisfaction (evaluation context) while trust concept is less mature and still complex but without doubt have huge impact in facilitation of cooperation in project teams. Both project management concepts show evident contribution to positive relationships between project stakeholders and ultimately project success and they are intertwined to some extent which is not investigated properly. Integrating different project management field (Xia et al., 2018) is meaningful for both theory and practice of PM adding new valuable ideas to existing models. In this paper goal is to explore relationship between SM and trust and thus with new insights and elaboration of their inter-relation contribute to construction project management field.

3. RESEARCH METHODOLOGY

In order to address the explicit relationship between concepts of stakeholder management and trust we undertook systematic literature review which consider top ten construction project management journals (*Construction Management and Economics*; (CME), *Journal of Construction Engineering and Management* (JCEM); *Engineering Construction and Architectural Management* (ECAM); *Journal of Management in Engineering* (JME); *International Journal of Project Management* (IJPM); *Automation in Construction* (AIC); *Building Research and Information* (BRI); *Project Management Journal* (PMJ); *Construction innovation* (CI)); *Facilities*) which are also used in several litera-

ture reviews papers on trust and stakeholder management in construction (Gad and Shane, 2014; Ceric, 2015a; Mok, Shen and Yang, 2015; Oppong, Chan and Dansoh, 2017) and two largest databases and search engines (WoS, Scopus).

mega-construction projects (Hu et al., 2013) in which main research streams and research topics of both concepts are well structured and highlighted. We followed several papers from stakeholder relationship management, project delivery

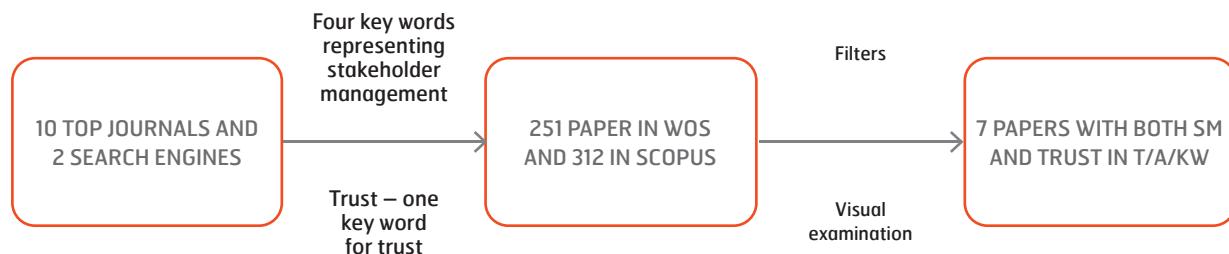


Figure 1. Systematic literature review – explicit relationship between SM and Trust concept

Because stakeholder management concept is well established, we used four key words as a proxy of SM concept and one for trust; „stakeholder management“ OR „stakeholder identification“ OR „stakeholder analysis“ OR „stakeholder engagement“ AND trust). Filter was used to exclude other research field like medicine and education as initial results in WoS and Scopus covered large field of research areas. Out of 251 paper in WoS and 312 in Scopus, using filtering and visual examination we identified 3 additional papers with explicit connection of SM and trust which resulted with only 7 papers in total (Figure 1).

Other part of our literature review was done with intent to extract implicit connection of observed concepts. We started by examination of five literature review papers on SM (Yang et al., 2009; Yang et al., 2011; Mok et al. 2015; Oppong et al., 2017), two literature review on trust in construction projects (Gad and Shane, 2014; Ceric, 2015a) and one on

method, stakeholder engagement and partnering research stream. In order to extract and sort papers we determined two categories; relationship management and project context of stakeholder relationships (table 1). Categories are based on McDermot (2005) point of view that managing trust can be performed by managing relationship directly or managing the context in which these relationship takes place. Among papers followed from mentioned SM and Trust literature reviews and papers found during initial review of literature (more than 60 papers) we choose 28 papers (table 1) in total which elaborates similar issues and thus are suitable for making implicit relationship. Papers are ranging from 2007. to 2018. which is interesting and leading to conclusion that in last ten years literature on two separate concepts indeed dealt with similar issues. We thoroughly examined them and reported on implicit relationship found in these papers.

Table 1. Papers chosen for analysis and extraction of implicit relationship between SM and trust concept

Implicit relationship between SM and trust concepts – papers related to management of stakeholder relationships		Implicit relationship between SM and trust concepts – papers related to project context in which stakeholder relationships takes place	
SM related papers	Trust related papers	SM related papers	Trust related papers
Stakeholder Management in Construction: An empirical study to address research gaps in previous studies (Yang et al., 2011b)	Trust in Construction Projects: Literature Analysis Using Keywords (Ceric, 2015a)	Stakeholder Management in Construction Projects: a Life Cycle Based Framework (Molwus 2014)	Trust in the Construction Industry: A Literature Review (Gad and Shane, 2014)
Critical Success Factors for Stakeholder Management: Construction Practitioners' Perspectives (Yang et al. 2009)	Interpersonal trust and inter-firm trust in construction projects (Lau and Rowlinson, 2009)	Impact of Procurement on Stakeholder Management (Rwelamila 2010)	Trust in construction projects (Ceric, 2015b)
A typology of operational approaches for stakeholder analysis and engagement (Yang et al, 2011a)	Trust-building in construction contracting: Mechanism and expectation (Chow et al., 2012)	Towards an improved understanding of project stakeholder landscapes (Aaltonen and Kujala, 2016)	Prior ties and trust development in project teams - A case study from the construction industry (Buvik and Rolfsen 2015)
Practical approaches for engaging stakeholders: findings from the UK (Chinyio and Akintoye, 2008)	Trust in projects: An empirical assessment of owner/contractor relationships (Pinto et al., 2009)	A comparative study of factors affecting the external stakeholder management process (Olander and Landin, 2008)	Building trust in construction projects (Khalfan et al 2007)
Project relationship management and the Stakeholder Circle (Bourne and Walker 2008)	The role of trust in project-stakeholder relationships: a study of a construction project (Karlsen et al 2008)	The evolution of stakeholder management practices in Australian mega construction projects (Yang et al., 2018)	Managing conflict in construction megaprojects: Leadership and third-party principles (Anderson and Polkinghorn, 2008)
Framework for stakeholder management in construction projects. (Yang and Shen 2015)	A framework for trust in construction contracting (Wong et al., 2008)	Improving Public Engagement in Construction Development Projects from a Stakeholder's Perspective (Leung et al., 2013)	Nexus of Interorganizational Trust, Principled Negotiation, and Joint Action for Improved Cost Performance: Survey of Chinese Megaprojects (Li et al., 2018)
Re-investigating Approaches on Defining Stakeholder Characteristics (Prebanic and Burcar Dunovic, 2017)	Developing a trust inventory for construction contracting (Cheung and Wong, 2011)	How to create a space for stakeholders' involvement in construction (Storvang and Clarke, 2014)	Relational partnerships: The importance of communication, trust and confidence and joint risk management in achieving project success (Doloi 2009)

4. RESULTS

4.1 Explicit relationship of Stakeholder management and Trust

Seven papers which was retrieved as those which provides explicit relationship of stakeholder management and trust concepts both having SM related keywords and trust in their titles, abstracts or keyword list (table 2). As papers vary greatly in terms of concepts elaboration and elaboration of their relationship, we classified their degree of concept elaboration and linkage through method which Littau et al. (2010) used for assessing qualitative contribution level of retrieved papers. This method divides papers in three level; when a paper simply mentioned the keyword (e.g observed concepts) without any explanation or deeper meaning we termed it a

Level III article (terminology application), when concept and its key aspects is explained and applied in any mean we defined it to be a Level II (theory application), when concept is discussed and developed further or enriched by new models or concepts, we classified it as a Level I article (concept enrichment). We will use it for both concepts which is shown in table 2 which also display other important information about examined papers (i.e source). It is a bit challenging to distinct level II and level III for trust as it is still vague concept so we used level II when trust was elaborated in some extant and III when it was simply used as a term even though in some level II and level III papers trust is used for similar arguments. Papers (Eskerod and Vaagaasar, 2014; Francisco de Oliveira and Rabechini, 2019) which enriched both concepts and made quality theoretical contribution were those elaborating explicit relationship of these concepts.

Table 2. Key aspects of explicit relationship between concepts

Paper title	Source	SM – degree of elaboration	Trust – degree of elaboration	Key point
Stakeholder management influence on trust in a project: A quantitative study	International Journal of Project Management (IJPM)	Level I – concept enrichment	Level I – concept enrichment	Positive influence of stakeholder engagement is proven on all three trust aspects
Stakeholder Management Strategies and Practices During a Project Course	Project Management Journal (PMJ)	Level I – concept enrichment	Level I – concept enrichment	Stakeholder management is done by planned and unplanned practices through the project life cycle and trust is both input and outcome of those SM practices.
Stakeholder management through empowerment: modelling project success	Construction Management and Economics (CME)	Level I – concept enrichment	Level II – theory application	Emergence of the emphasis on trust and trust development in context of stakeholder empowerment (management)
Stakeholders and uncertainty management in projects	Construction Management and Economics (CME)	Level II – theory application	Level III – terminology application	Stakeholder analysis enables implementation of proper stakeholder management and facilitates trust development
Enhancing Stakeholder Management Competences in Construction Projects using Serious Games	Proceedings of the 9th Nordic Construction Economics and Organization Conference	Level II – theory application	Level III – terminology application	Trust building observed as an individual SM competence (OKEI framework of competences)

The implementation of stakeholder management and Building Information Modelling (BIM) in UK construction projects	Proceeding of the 34th Annual ARCOM Conference	Level II –theory application	Level III – terminology application	BIM provides the opportunity to engage concerned stakeholders and incorporate their feedback in project decisions which enhances trust
Collaborative and cross-company project management within the automotive industry using the Balanced Scorecard	International Journal of Managing Projects in Business (IJMPB)	Level III – terminology application	Level III – terminology application	N/A

Francisco de Oliveira and Rabechini (2019) elaborates SM and Trust concepts in detail and examines the influence of SM activities on trust development in projects. Stakeholder management is operationalized through prescriptive SM (e.g. stakeholder analysis) and relational SM (e.g. stakeholder engagement) and Trust through three trust types (competence, integrity, intuitive). Empirical survey is done on more than 100 PM's in Brazil covering various industries and positive influence of stakeholder engagement on all trust aspects is proven which is the explicit case of SM and trust concept inter-relation and thus contributes to both field(Francisco de Oliveira and Rabechini, 2019). Nevertheless, these results were expected because elaboration of positive stakeholder influence on trust was presented earlier but with less rigor method (Eskerod and Vaagaasar, 2014). Eskerod and Vaagaasar (2014) performed longitudinal study and observed how stakeholder management practices emerged and evolved as embedded actions related to perception of each stakeholder harm and help potential which is a way to classify stakeholders. They showed how the SM consisted of both planned and emergent actions and how trust developed, along with the SM practices, being both input to and outcomes of the practices that evolved which is another case of very explicit relationship of concepts. Rowlinson and Cheung (2008) explored stakeholder empowerment as a part of relationship management (RM) which they described as close concept to stakeholder management and defined trust as one of the consequences of proper RM and SM. They stated that one of the important factors of their exploratory study was emergence of the emphasis on trust and trust development in context of stakeholder empowerment. Ward and Chapman (2008) presented framework for uncertainty management with focus on stakeholder-related uncertainties and emphasized the

role of various stakeholder analysis approaches in uncertainty management. In that manner they stated that proper stakeholder management and trust development is enabled through stakeholder analysis and that SM and trust contributes to uncertainty management. Ekambaram and Petersen (2017) examined novel ways to enhance stakeholder management competences in construction projects and positioned trust building as a soft skill according to IPMA classification and as an individual competence according to OKEI framework. Authors mentioned trust only twice concluding that it is SM related competence. Singh et al (2018) examined possibilities of stakeholder management in building information modelling (BIM) project and thus provided novel insights since SM hasn't been investigated on BIM projects. BIM provides the opportunity to engage concerned stakeholders and made project stakeholders to meet frequently by using visual means which promoted trust. Feedback that was taken into account and frequent communication which is characteristics of good BIM project contributed to project trust (Singh, et al., 2018). The elaboration of SM and Trust implication in collaborative and cross-company projects were too much tailored for the CPS context of automotive industry which prevents to make assumptions for construction project management.

4.2 Implicit relationship of Stakeholder management and Trust

This section will elaborate relationship between two observed concepts which are not explicitly highlighted in literature but can be made if thorough examination and analysis of SM and trust papers is performed. As McDermott (2005) stated, in order to facilitate trust PM can manage relationship directly or he can manage context of relationship. This

starting point was used in literature sorting for this other part which is described in methodology and two subsections will refer to project and relationship management context. Industry context and context of parent organization (of project stakeholders) are out of scope of this paper.

4.2.1. Implicit relationship of SM and Trust – relationship management context

Literature review (Ceric, 2015) about trust in construction projects revealed that relationship management was associated key word (to trust) which appeared 3 times with trust, and client-contractor relationship appeared also 3 times (among 42 papers) which clearly indicate that relationship management is important to trust concept. Also communication appeared 5 times (Ceric, 2015) which is essential part of relationship management (Yang et al., 2009; Bourne, 2010) and stakeholder didn't appear as associated key concept at all. Literature reviews on SM in construction (Yang et al., 2011a) explicitly stated relationship management as one of the most important research category with 22 papers related with relationship management (among 68) from which 14 falls in one subcategory which is referring to promotion of dyadic project stakeholder relationship which is related to trust. Relationships are generally described as good or bad, positive or negative and trust is a common quality of positive stakeholder relationships (Karlsen et al. 2008; Lau and Rowlinson, 2009). Chow et al (2012) examined trust-building mechanisms (22 mechanisms) and trust expectation (14 attributes) while Wong et al. (2008) and Cheung and Wong (2011) devised trust measurement systems. These papers deals with trust without any reference on stakeholder management while many of those trust-building mechanisms (i.e "investing time and rooms for mutual understanding") (Chow et al 2012) are describing way to build relationship which is also covered in SM literature (Chinyio and Akintoye, 2008; Yang et al., 2011b) dealing with stakeholder engagement approaches ("workshops and focus group meeting"). One of the trust-expectation factors is responsiveness (Chow et al 2012) while Bourne et al (2008) elaborates receptiveness as part of monitoring effectiveness of stakeholder engagement. In the same way Wong et al. (2008) and Cheung and Wong (2011) measures trust in stakeholder relationships through categories of "communication/interaction" and

"emotional investment" while Bourne et al (2008) monitors "stakeholders support" in stakeholder engagement system. Pinto et al (2009) measures effect of trust on satisfaction of working relationship and consequently on project success which is align with Yang and Shen (2015) and Bourne et al (2008) models which are placing its last SM related process on evaluation of satisfaction and relationship quality. Vague concepts of stakeholder characteristics and related issues of what should be measured as stakeholder quality were mentioned in literature (Prebanic and Burcar Dunovic, 2017).

4.2.2. Implicit relationship of SM and Trust – project context affecting stakeholder relationships

Both literature review's on trust in construction (God and Shane, 2014; Ceric, 2015a) elaborated that project delivery method e.g. partnering was very important research category which is essentially dealing with ways to decrease the adversarial environment, increase cooperation, and reduce inefficiencies in construction projects. On the other side Rwelamila (2010) emphasizes selection of the most appropriate organization for the design and construction of the project as fundamental aspect of the construction project process and Molwus (2014) claims that perception of success for project stakeholders is dependent of chosen procurement route (i.e delivery method). Buvik and Rolfsen (2015) stated that to facilitate trust one must take great care of project environment and contracting. In these papers related to either concept emphasis is put on the importance of project settings and delivery methods which results in similar arguments and conclusions from SM and trust related papers but little or none cross-reference between them.

Topic of project setting is especially important when it comes to megaprojects because there is complex stakeholder landscape shaping the context of the project (Aaltonen and Kujala, 2016) and there is a natural tendency for stakeholder groups to try to influence the implementation of construction projects in line with their individual concerns and needs (Khalfan et al., 2007; Olander and Landin, 2008).

Table 3. Key aspects of implicit relationship between trust and stakeholder concepts

Key aspects of implicit relationship – relationship management context		Key aspects of implicit relationship – wider project context	
Trust concept	Stakeholder management concept	Trust concept	Stakeholder management concept
Systematic literature review – in 6 papers from 42 key word relationship is associated with key word trust	Systematic literature review – 22 papers from 68 are categorized as relationship management but 14 can be observed as suitable for implicit link	Partnering, alliance, project delivery method	Procurement route, construction procurement system
Trust-building mechanism (i.e. investing time and rooms for mutual understanding)	Stakeholder engagement action (i.e. workshops, public hearing, focus groups)	Key is public trust	Key is public engagement
Attribute of trust expectation – responsiveness and work relation satisfaction	Attribute of stakeholder engagement monitoring system – receptiveness and stakeholder satisfaction	Joint actions in collaborative project environment	Stakeholder empowerment and involvement in project
Categories of trust measurement – communication/interaction and emotional investment	Categories of stakeholder management evaluation – stakeholder support and commitment	Trust is most effective strategy to minimize communication risk	Management of engagement process is essential part of risk management

Bourne et al (2008) stated that it is important to recognize that management of the engagement process is an essential part of a risk management plan and Ceric (2015a) underpin trust as the most effective strategy to minimize communication risk. Shift from internal to external stakeholder management is seen in both trust and SM concept in mega project. Anderson and Polkinghorn (2008) concluded that public trust is the key success factor for construction mega project (MCP) and both researches from Yang et al (2018) and Leung et al (2013) concluded that public engagement is the key for construction mega project. Rowlinson and Cheung (2008) propose empowerment of stakeholders and Storväng and Clarke (2014) investigates how to involve external stakeholders in construction projects both papers aiming to frame a collaborative project setting. In megaprojects trust is elaborated in context of relational governance (Doloi, 2009; Li et al., 2018) which emphasizes communication, trust, joint actions with goal to enhance collaborative project environment. Main factors of implicit relationship of stakeholder management and trust concept are shown in table 2.

5. DISCUSSION AND CONCLUSION

Based on literature reviewed in this paper it can be concluded that trust is elusive and multifaceted concept in construction project management area which have diversified meaning in different situation and from different point of views while stakeholder management concept is considered moderately mature in construction project management. Construction project management (CPM) observes trust mainly from strategic perspective which is the same dominant perspective that CPM holds for stakeholder management. First research goal of this paper was to extract explicit relationship between SM and trust concepts in which SM was examined through four key words (e.g. usual expressions for key SM processes) and trust with one. Seven papers with explicit relationship was thoroughly examined and main point of inter-relationship implication were highlighted. Second research goal was to extract implicit relationship of those concepts which is done by thorough examination of 28 papers from both SM and trust field sorted in two research streams; stakeholder relationships management and pro-

ject context shaping stakeholder relationships. Papers related with project context are slightly more relevant for trust and SM in megaprojects. In SM papers dealing with stakeholder relationships and procurement systems trust wasn't observed as related concept and the same situation was in case of trust related papers which emphasized relationship management and partnering delivery methods as an important topic without any reference on stakeholder management concept.

These insights from reviewing literature can serve as a critic for key word literature review methodology as it is apparent that related concepts don't necessarily share same expressions (terms) in title, abstract and key word list. If one wants to examine all important aspects of a concept, he must go beyond some obvious boundary which Eskerod et al. (2015) and Ceric (2015) pointed out in their papers. Synthesis of two different project management fields or related concepts can enrich existing frameworks, models and improve project management practices thus providing meaningful theoretical and practical contribution to both fields. This is also advocated by Xia et al. (2018) in their work on risk and stakeholder management integration.

Except rare examples of explicitly presented connection between trust and stakeholder management which proves that SM have positive effect on trust development it is evident from chosen literature that trust and stakeholder management both fosters project collaboration, reduces the risk of opportunism and possible conflicts and ultimately contributes to achievement of stakeholder satisfaction. Also, both concepts are closely linked to stakeholder relationship management which points to profound implicit connection between these two distinct concepts. Positive implications that trust and SM bring to PM can be enhanced if insights from both fields are incorporated in existing PM models related to trust or SM. Aspects of SM and trust linked with

relationship management could be integrated in existing stakeholder management models as a part of stakeholder engagement process. Operational approaches to external stakeholder engagement and approaches internal project team (i.e meetings, public hearings, focus groups) could incorporate some of the trust-building mechanisms and trust-measuring system could be added to evaluation system of stakeholder engagement (i.e evaluation stakeholder of responsiveness and support through trust). This type of stakeholder relationship management based on trust building and trust measurement would serve as a mean to adjust stakeholder management actions and improve analysis of potential stakeholder influence on project. Project management system should be able to provide assessment of trust level necessary for achieving cooperation and information sharing within project team as well as level of public trust needed to avoid project opposition. This could be achieved if both trust and SM related practices are placed in same part of PM system. In project front-end phase where decisions about project delivery and procurement are made, alignment of stakeholder needs and concerns along with trust-building potential should be evaluated and used in decision making process thus helping to avoid conflicting project setting.

Further researches should be made to position relationship management and related trust aspects in stakeholder management practices and project delivery strategies. Limitation of this paper is that stakeholder management concept can be considered in broader terms than it is described in this paper (i.e. social and environmental context) and thus some other key words could be added and more relationships between concepts could be found. Further research should enlarge the scope of literature review with social and environment context of PM and other research areas or industry contexts which could lead to new insights and further advancement of PM theory and practice.

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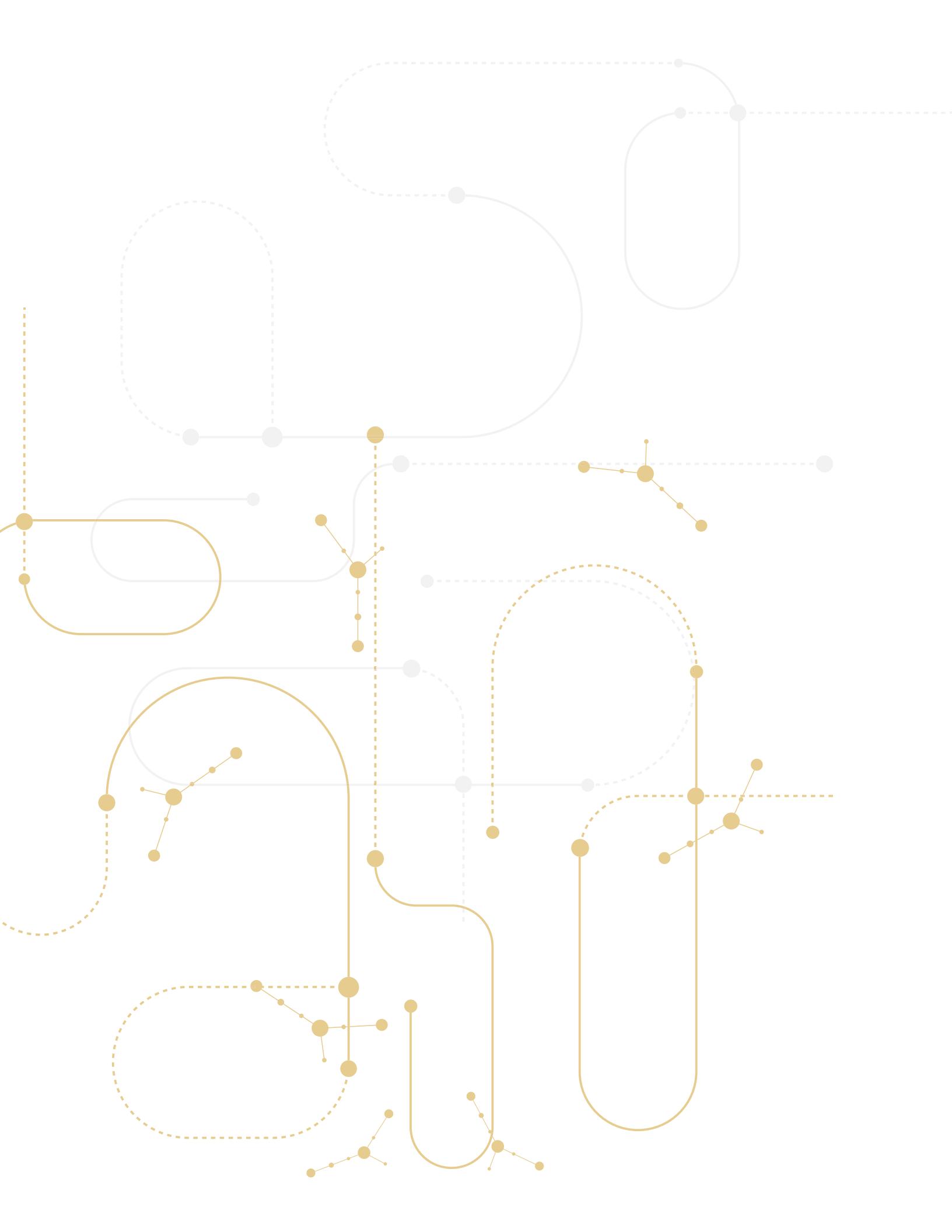
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III.

Trust as Leaver of Success in Projects



Project Delay: Causes and Remedies

ABSTRACT

All projects involve a number of discrete stages from project initiation through to project closure. Whilst accepting that good work quality is a key requirement, this study evaluates each project stage from two other key aspects, namely cost and schedule. As the project reaches closure, all attention will be focused on the planned project completion date and delays can and generally will affect the planned completion date. This paper provides a brief discussion of possible project delay causes, classifying them under eight generic types. A review of a number of projects – both closed and still active – was carried out to identify the types of delays experienced and how long they lasted. All such project delays and their causes can be avoided if a project is well planned and all required resources are made available.

Keywords: Project Delay; Causes; Remedies; Delay Average; Delay Contributors

1. INTRODUCTION

Within any project, all types of delays can be experienced. Most studies of project delays concentrate on ranking them based on their impact and probability. Insufficient attention has been paid to analyzing the causes of each type of delay and developing solutions to eliminate them. The most important single factor in preventing all types of project delay is planning. Planning is not only scheduling. It involves addressing all factors that can adversely impact an activity or task and taking measure to ensure the readiness of the activity or task to be implemented.

Project schedules are estimated based on a number of considerations, including the schedules for previous similar successful projects, historical cost estimates and three point estimates. These estimates will inevitably contain uncertainties, which require to be addressed through a contingency plan. We have to accept the uncertainties, even if the schedule was well prepared. However, all potential project delays require to be identified before searching for solutions to eliminate or minimize their effects. What makes a project successful is not the plan. It is the experience and understanding of those who are planning the project. Based on their efforts, the plan can be tuned to produce a schedule that more realistically and accurately reflects the correct time of completion and date of celebration.

Many researchers have studied project delays. Through a questionnaire, Sambasivan and Soon [1] identified the 10 most important delay causes faced in Malaysian construction industry projects. In another questionnaire survey, Afshari et al. [2] identified the key causes of non-excusable construction delays. Based on analysis of collected data, Hafez and Elsaka [3] found that the most important factors causing delays in public building projects were financial, and related to the lack of construction material. Ramanathan et al. [4] identified 18 categories of project delay causes and addressed their related time and cost risks. Assaf and Al-Hejji [5] identified 73 delay causes in construction projects in Saudi Arabia and calculated the importance index for each cause as the product of the frequency and severity of each cause.

From an analysis of a large number of completed and ongoing projects, this paper identifies the eight primary causes of project delays as project management, the project team,

the contract, the contractor, safety issues, organization assets, the proponent or customer and even Mother Nature. It sets out to identify the specific types of project delay introduced or exacerbated by each cause, with the objective of enabling them to be avoided in future projects.

2. PROJECT DELAY FOR CLOSED AND ACTIVE PROJECT

Data from 21 completed projects – selected arbitrarily – was analyzed to establish the reasons for projects delays. The average project delay was found to be 17 months, and the longest was 4 years. The major reasons for delay were found to include: scope addition and deletion; scope redefinition; delay in contract award; poor contractor performance; limited contractor experience; bidder quotation higher than the project budget; additional proponent requirements; lack of funding for change orders; delays in material delivery; equipment relocation; and adverse weather conditions.

Similar analysis was carried out on 31 active projects – also selected arbitrarily – to establish the reason for project delays. The average delay was found to be 4 months and the longest delay was 2 years. The major identified reasons for delay included: scope addition and deletion; scope redefinition; delay in contract award and poor contractor performance.

All the above delay causes were related to poor planning. They could be eliminated at the start of the project if sufficient time was allocated to collect information, and understand and manage each activity within the project. This requires the availability of specialists who possess the knowledge and experience to plan, prepare responses for and provide working solutions to eliminate unwanted issues.

2.1 Project Management Contribution to Delay

Project Management contributions to delay causes include but are not limited to;

- **Premature Decision to Award the Contract:** A project is usually expedited in its early stages. When the time for bidding is shortened and actions and responses are undertaken quickly, poor evaluation of bids can be made and approved. As a result, a contractor that is unable to
- meet the project requirements may be selected. When no penalties are included in the contract, the contractor will not hesitate to submit a bid, irrespective of whether the contract includes an unreasonable schedule to meet proponent requirements. Selecting an unqualified contractor will result in change orders, rework and project delivery rejection.

- **Being Overconfident:** Overconfidence may lead to wrong decisions being made by accepting recommendations from other parties without investigation; considering them as specialists; that their designs must be correct; and ignoring the need for site surveys for verification. During project implementation, issues and problems may begin to become evident, indicating that the basic design needs to re-evaluated and corrected to meet the required project objectives.
- **Lacking Confidence:** A stakeholder may not have the confidence to make a decision as a result of not involving or updating other stakeholders with the correct information or at the correct time, to make the right decision. If a stakeholder is hesitant or anxious about making decisions, the project is likely to incur delays and uncertainties, which could impact the project success.
- **Making Decisions Under Pressure:** Having to make decisions when the Project Manager is under pressure could result in accepting deliverables and agreeing on working solutions which may not meet the project requirements and standards; or may not involve important stakeholders. This situation can be avoided by including the whole project team in the decision-making process, or postponing decisions to a time when the management is calm and able to think and act more carefully and correctly.

- **Personal Interest:** Some employees may be assigned to higher project positions than their capability justifies. It may be in their interests to delay the project, as completing the project on time could lead them to lose their elevated position. Other employees may enjoy the project working facilities and perform slowly to avoid losing the benefits of provided work situation.
- **Not Possessing Management and Leadership Skills:** The success of any project depends on the Project Managers and Leaders, who are required to possess vital

management and leadership skills to produce a quality product. These individuals need to understand how to influence others to gain their support in achieving the required goals by creating and communicating their vision and ensuring that the team is committed to the project objectives and goals. They are required to establish an emotional connection and mutual understanding with their teams and to listen to them and help them to resolve their problems. They need to observe and evaluate the project progress and team performance and teach team members how to identify problems, develop solutions and have them implemented. They are required to build the confidence and interaction of their teams to encourage the team to take more responsibility in expediting the project progress. If the Project Managers only focus on schedule or budget and do not address the project team requirements and concerns, the team may become demoralized and may not be committed to, or interested in, the project and this will inevitably result in delays.

- **Favoritism:** Based on favoritism, many non-competent persons may be selected and assigned to activities beyond their capabilities and occupy positions that should be held by others with greater competence. Favoritism impacts on, and may easily erode, team unity and cohesiveness by building barriers. It may make competent employees ineffective by preventing them from sharing their opinions and ideas.
- **Writing Skills:** Good writing skills are required to convey the right messages and management is required to ensure that an acceptably high level of grammar is being achieved. Selecting the correct wording is essential to deliver the required message and to ensure that it clearly conveys the message. A letter is an official way to share information and has to be accurate and precise.
- **Dictatorial Decision Making:** Dictatorship in decision-making, when a single person makes a decision and others have to follow, may damage the project. Decisions based on a single input may adversely impact established plans, activities and schedule. They can impact team momentum and interest in achieving project objectives, if their inputs and decisions are being ignored, preventing them from achieving original goals.

• **Management Team Selection:** Selecting a member for a team is a sophisticated process and the human resources team may not have the required selection capability. Even if there is a suitable selection specialist, he may not be available for a particular project. The alternatives are either to live with a less well qualified team and suffer project delays and rework or to start to educate the available team members to achieve better performances and results. Educating the team members is the most effective way to produce members who are competent and understand the project objectives. Educational processes do, however, consume time and should be considered in the project schedule or contingency plan. Running the project with a qualified and educated team should eliminate delays resulting from rework or a lack of knowledge.

- **Loss of Control:** If the Project or Team Leader is weak or has no authority or limited experience and does not take action he had promised to take, this is likely to adversely affect project progress. Team members will not respect their Leader, and will run project activities as they judge and wish. The project is likely to lose its control unless the weak and poorly experienced Leader is replaced with someone who has the required qualifications, experience and competence to manage the work.
- Personal Development: Everybody in the team is working to feel self-satisfied within the project. Self-satisfaction is related to self-promotion, development and appreciation. Unfair evaluation of their performance and capabilities creates emotional barriers for a person, which may affect his creativity and ability to improve the project's progresses.

2.2 Project Team Contribution to Delay

Project team contributions to delay causes include but are not limited to;

- **Project Selection Criteria:** Selection criteria used for contractors, suppliers and all personnel involved require to be correctly set and carefully and consistently applied to avoid hiring inadequately qualified contractors, unsuitable personnel or risk receiving poor quality or incorrect materials.

- **Dissatisfaction:** Dissatisfaction with employment or work conditions could impact the team morality. Project Manager should ensure that the team members are satisfied with the following aspects: work; food; lodging; transportation; health care and personal respect.
- **Language Barriers:** Workers may come from different countries and speak different languages. Therefore language is considered as a potential barrier. The personnel involved may possess the required knowledge, experience and skills but they also require to be proficient in the use of the project working language. Translating project information into different languages should help their understanding and enable them to follow the project specification and scope more clearly.
- **Meeting Overall Project Objectives:** Projects are often broken down into small work packages and activities, with these packages being integrated together to produce the final product. However, the overall project objective cannot be achieved correctly if the work packages are not correlated to produce the final result. Teams working independently may result in deliverables being produced which cannot be integrated or interfaced together, and this may result in the development of non-compatible products. It is therefore important to focus on the overall project objectives and work together with other teams, in the knowledge that each activity will make an important contribution to the overall project objective and deliverables. Rework and distract are often a result of not understanding how activities are related to the final product.
- **Document Approval:** Approval of documentation, design, specifications and other deliverables should be carried out through controlled procedures. This ensures that they are adequate and acceptable and reflect the requirements of the work scope. Late document submission, missing documents and inaccurate or incomplete contents may prevent approval for materials or activities being achieved on a timely basis. This situation could result in the approval process having to be repeated several times and delaying the project.
- **Late Response:** Late response may be due to employees being overloaded, not qualified or having difficulties obtaining the required data to make decisions. It may also be due to distance, lack of access to locations or the complexity of the required information. If employees are excessively busy because they are handling many activities simultaneously, the most effective way for the project to be completed is to arrange for its activities to be run in series by an adequate number of employees.
- **Fear and Anxiety:** Fear and anxiety about job security can either paralyze or energize individuals to make changes and accept and face challenges. Fear and anxiety can be controlled and managed by involving team members in workshops, to overcome this fear, and helping them to work as valued team members.
- **Trust:** Trust is gained gradually and results in mutual respect between the project management and team members. Gaining trust is a sign of growth and accomplishment and confirms the ability to achieve project objectives. Without trust, project team members are unlikely to be creative or committed to the project activities.
- **Site Visits:** Project employees may become reluctant to visit a site to verify that the design package and drawings reflect the correct site layout. The design package must include items that need to be rectified before the project implementation takes place. The discovery of underground cables or ducts, old tanks or pipes may result in a design change and a delay in project implementation.
- **Employee Turnover:** Turnover notes from one employee to another may not be comprehensive and provide the full required information. Having a suitable deputy working with a designated employee before he/she leaves is the best way to manage the handover of duties. When qualified personnel leave for an extended period, this can adversely affect project progress unless a robust handover plan had been put in place, and is followed and implemented.
- **Leaves and Vacations:** It is not easy to convince an individual to delay his vacation, particularly if it was planned for a certain occasion. Leaves are not reflected in the project schedule or correlated with work progress. Emergency leaves and annual vacations can, however, impact the project schedule, especially, if the correct replacement is not available and if the leave coincides with a period when a number of important activities require to take place.

- **Morale:** Morale is related to job satisfaction. Satisfaction has to do with salary, type of work, respect, synergy, sympathy and harmony. The worker has to be respected no matter where he is located in the organization structure. He/she has value and contributes to the final product. Morale is boosted if the worker feels himself to be important and respected and good morale will motivate the worker to expedite the project work.
- **Feeling of Accomplishment:** Completing important project deliverables may cause teams to feel elated and cause them to relax and the pressure on them to complete other works may lessen. This will result either in workers slowing down or the team being encouraged to expedite the work progress after being inspired by the feeling of accomplishment.
- **Animosity:** Successful team members are sometimes envied by others and this may harm team cohesiveness. Team members are required to work together to improve individual team member performance, as well as developing mutual respect between them. It is important to help jealous members correct their behavior and avoid conflicts that could affect team performance and hence the project schedule.
- **Team Contribution to Project Problems:** Team members should feel relaxed working together to develop solutions to resolve project problems. In addition to improving the trust between team members, this will lessen the wariness that some individuals feel about being individually responsible and accountable for decisions. It will also help in making correct decisions and quickly implementing the right solutions.
- **Being Driven to a Conclusion:** The contractor and the proponent are trying to persuade one another to reach particular conclusions by offering opinions that are designed to bias the decisions reached. Although the end result may not be agreed, such opinions may influence the final decision and such biased decisions may result in the development of deliverable containing flaws.
- **Knowledge:** Knowledge is the stepping stone to preparing and building the project schedule. Without knowledge, the schedule may not be prepared or developed correctly. Knowledge of deliverable requirements helps to break tasks down into small packages and to develop correct estimates for time and resource requirements.
- **Experience:** Experience is a key factor in correcting the schedule, identifying workaround solutions to problems and discovering risks that might impact the schedule during all project stages. Experience enables a team to distinguish between correct and incorrect schedule estimates for a project activity.
- **Team Conflicts:** Members with similar interests may build a coalition within a project, hide information and generate problems for those who are not part of their coalition. This frequently impacts project cost and schedule. Building a coalition within a project makes the team members loyal to their coalition leader and not to the project itself. To eliminate the problem, team building activities should be used to help the team members work together, learn to trust each other and become organized to handle project issues smoothly and effectively.
- **Meetings:** Meetings are required to clarify methodology and objectives, request support, work on issues, reach consensus and obtain feedback from project stakeholders. Project teams are involved in meetings to correct project performance and eliminate project delays. Although meetings are important, the time required to prepare and take part in them can distract attention from completing or tracking important deliverables within the project. More often than not, meetings result in new requirements, which the project team has to verify and work out. Meetings can also consume more time than planned, although a good agenda and planning are beneficial for conducting productive and effectively managed meetings.
- **Poor Qualification:** Selection of correct and competent project team members is carried out based upon their qualifications and experience and the attitude and objectives demonstrated during interviews. Inadequately qualified people may, however, have to be considered due to limited or non-availability of personnel with the required specializations, experience or personal qualities.

2.3 Contract Contribution to Project Delay

Contract contributions to delay causes include but are not limited to;

- **Contracting Department Procedures and Processes:** Contracts are processed by the Contracting Department in a queue, usually on a first come, first served basis. Vendors and bidders will often also request more time to submit their offers and the Contracting Department may extend the contract bidding period to seek more offers, thereby causing project delays.
- **Disputes:** Contract disputes cause delays and impact project performance. They may be considered as a pretext by the contractor to gain more time and delay the project when the required resources are not available. Such delays may appear justifiable and are unlikely to financially impact the contractor. A dispute may be related to the project scope or specific requirements which may not be clear or open to different interpretations, leading to claims for additional cost and time to complete the project.

2.4 Contractor Contribution to Project Delay

Contractor contributions to delay causes include, but are not limited to;

- **Bankruptcy:** The contractor may go bankrupt and be unable to fund the project activities. This would be a critical situation and a clause requires to be inserted in the contract to allow the proponent to hire another contractor to take action, if the primary contractor fails to carry out the required project work within a specific time.
- False Representation: The contractor may tell lies to win the contract, seek to justify delays, hide an issue of concern, or claim progress that has not been achieved. If the contractor is handling a number of projects and has limited resources to deal with them, it may not identify this limitation in its capabilities. Hiding issues within a project is one of the main reasons for delays. Discovering a problem in a project is estimated to consume 75% of the effort, with 25% of the effort being required to correct the problem.
- **Equipment Malfunction:** To minimize equipment malfunctions at the construction site, it is an essential requirement to test heavy equipment to ensure that it is functioning correctly and effectively before sending it to site, and hence eliminate the unwanted consequences of malfunction from impacting project schedule.
- **Corrective Actions:** Carrying out the work activities correctly and to the required specification saves time. It avoids the need for corrective action, which results in re-work and repeating procedures to verify the acceptability of the deliverable.
- **Documentation Control:** It is essential to systematically organize and control documents that are sent to the proponent for approval. These documents are usually sent to request approval of a design package, payment of an invoice, access to the proponent facility, etc. The system for organizing and controlling the documents sent to the proponent should include tracking procedures to enable continuous updating of document status and avoid duplicated requests.
- **Test Equipment:** Test equipment should be sent for calibration as per manufacturer instructions. Use of the equipment should be reserved only for those tasks for which it has been designed. Failure to maintain this equipment in good condition or provide suitable technical support may result in it not being available when required due to breakdown or absence of a certified technician, which in turn can impact project progress.
- **Test Agent:** Several approvals may need to be secured to start or continue civil engineering work at a new location. These approvals may need to be obtained from the government or the proponent and may require soil samples to be collected and tested or data to be analyzed by a certified testing agency. The testing agency may have offices only in major cities and not be interested in opening locations in remote area, unless this is justified by the cost. Establishing a local testing agency should be considered in the bidding stages, to avoid the additional cost and time required to transport test samples to distant locations, and avoid the delays to project activities that this is likely to cause.

- **Materials:** The unavailability of the required materials at site when required is generally the main reason for project delays. Monitoring the progress of a project is likely to raise many alarms regarding material availability. Materials may not be ordered on time, as the technical requirements may not be developed on a timely basis or the procurement agent may be searching for the lowest bidder or may not be prepared to make a decision about suppliers if the cost is high. There are, however, methods that are available to expedite material delivery. Once the purchase requisition is awarded, material procurement and delivery should be tracked from the manufacturer to the carrier, customs, shipping and clearance agents. The project proponent can often help in expediting the material delivery, as some proponents have previously dealt with many vendors and manufacturers. They can help convince suppliers to expedite the material orders, especially for materials and equipment that are in high demand with a long queue of orders pending.
- **Manpower:** There is constant high demand for skilled labour of all technical disciplines. They are needed for designing, implementing, testing and verifying deliverables. The labour force may be in short supply or be impacted by labour laws and regulations. Failure to look after the workforce, such as the failure to pay salaries on time, or to provide incentives could result in labor unrest and work delays.
- **Labour:** Unavailability of appropriately skilled labour may result in having to hire personnel with fewer skills to do the work. Performance will not be at the same pace, although there is still likely to be progress, with some delays, depending on the quality and professionalism of the assigned team.
- **Heavy Equipment:** Leasing heavy equipment can be expensive. A contractor may be reluctant to use safe and fast equipment if cheaper options are available, irrespective of the impact on safety or time. For example, a communication tower could be erected with a crane or a gin pole. Building a tower with a crane is expensive but it is also safer and faster compared with using a gin pole. Heavy equipment like cranes also mandates the availability of certified riggers, who are highly paid and may not be available if their services are in high demand. Availability of heavy equipment is also an issue and having it transported poses challenges, especially over irregular roads or across desert, which make the transfer of heavy equipment a risky and time consuming process that requires detailed planning.
- **Low Cost Solutions:** It is important for a contractor to minimize cost, irrespective of whether this results in a solution that may delay the project. Usually the awarded bidder is the one who offered the lowest price and in order to maximize his profit, the bidder will select low cost labour, who may not be knowledgeable about the procedures, the standards or the work to be carried out. This is likely to impact project quality and performance indices. Therefore bidders must be confirmed as being able to meet project technical requirements before being permitted to bid. As the contractor tries to save money by trading cost against time, he may delay the project and provide a pretext for a delay, which in the absence of verification may appear to be justified to a proponent. If the contract does not include penalties to punish the contractor for lateness in delivery, the contractor will be largely unconcerned about meeting the deadlines for the project deliverables and hence about project delays, if they save him money.
- **Team Work and Performance:** Each member of a team has his/her own role to play. Everyone should understand his/her role and what is expected of other team members, to enable them to work together effectively to achieve the project milestones on time. A disorganized or unbalanced team is likely to produce deliverables with defects and that require rework and delay reaching the planned targets.
- **Salary Delay:** Salary delays may result in strike action, and/or site damage and theft by employees, who may justify such behavior as "earned compensation." This type of delay can be very disruptive, as many low-paid employees live from paycheck to paycheck and are concerned about their families having sufficient money to live on. This situation can seriously demotivate previously creative and/or hard working employees.
- **Involvement in Other Projects:** Proponent and contractor may have different projects to handle simultaneously. Their resources and efforts will then be divided among these projects. Logically, focus will be concen-

trated on more profitable projects with less attention being paid to alleviate unjustifiable delays on less profitable projects.

- **Procrastination:** The feeling of having enough time to resolve project issues may not be always correct. Some work can be carried out at any time during the project stages, but procrastination may result in issues not being addressed at appropriate stages, as they are not part of a critical path. With appropriate planning, such work could and should also be completed during periods when important activities are suspended due to obstacles, such as a preceding task not being completed.
- **Contagious Diseases:** A disease could cause delay if it is communicable and impacts a large number of workers. Project planning should include worker healthcare, on-site health inspections, and vaccination requirements for all staff.
- **Tasks Dependencies:** It is important to highlight the relationships between tasks in a schedule. Some tasks require to be completed before starting a new activity whilst others are independent tasks that can be executed at any time during the project. Failure to properly identify sequential tasks in advance is likely to result in delays with resources being left idle, as workers wait for tasks to be completed.
- **Physical Obstacles:** The contractor may continue working on a site although certain physical obstacles are present that need to be cleared. Obstacles may not prevent work activities but they can result in project delays.

2.5 Safety Related Delay

Safety contributions to delay causes include but are not limited to;

- **Traffic Factors:** Project teams travel to deliver materials and conduct project activities. A number of factors may prevent the team from reaching the construction site on time, including traffic conditions, driving behaviour, weather and road design and conditions.
- **Safety at Work:** Safety at work is very important to prevent worker injuries and deaths. Hundreds of people are killed annually in accidents at work, and thousands of people are injured. Accidents at work cost society billions of dollars to compensate for deaths and to treat injured workers. Accidents at work may damage equipment and facilities, delay project activities and negatively impact both team morale and the contractor's reputation. Accidents may result in proponents applying more stringent safety precautions to protect their facilities. Safety violations may even result in terminating the contract and blacklisting the contractor from being considered for future projects.
- **Day and Night Working Hours:** During the year, the day and night working hours change. Certain activities may not be allowed to be conducted during night hours, due to the nature of the work, safety impact and criticality of the area. Changes in day and night hour times may result in a delay for some activities which could impact the project schedule.
- **Road Accidents:** Road accidents may result in causalities and injuries and seriously impact the project progress. Qualified teams are not easy to build and are difficult to replace. They were selected, trained and familiarized with the project scope. Project team members may be involved in accidents which affect them physically and emotionally. Their loss will invariably adversely affect the cost and time required to complete tasks and this is likely to impact the project completion date. Disseminating work progress information to all team members is crucial and could minimize any delay due to accidents by bringing other team members and teams to the required level of knowledge, allowing them to carry out the work activities of the affected team members and impacted teams.
- **Violations:** A facilities mandate is critical for applying strict rules to protect against damage. Some of these rules are concerned with traffic control inside and outside the facilities. Not adhering to the traffic rules may result in confiscating a driver's license, seizing his car, stopping the driver from entering the facilities or even terminating the contractor on the basis of him violating the safety requirements. Another example might be if a short circuit in an underground power cable from an ongoing project caused damage to existing proponent electrical equipment. This might result in associated project activities

being stopped until stricter control measures can be applied to minimize the likelihood of similar future problems.

2.6 Organization Assets Related Delay

Organization assets contributions to delay causes include but are not limited to;

- **Communication Medium:** The communication medium is the system that is used to transfer information among the stakeholders. It may involve the use of radio, television, wire, satellite, or cable to distribute information. The reliability of the system is vital to ensure that messages are delivered to the recipients on a timely basis. It should also be secure to ensure that data is not accessible to external sources. Communication is susceptible to noise, interference, hardware and software problems. If the communication medium is not secure and well protected, external sources may be able to hack into it and cause damage to the system. This may result in disturbance to the schedule activities and delay the project.
- **Communication Channel Development and Implementation:** Communication channels and networks must be established. Communication is very important to project success. It is essential to deliver the correct messages on a timely basis and keep team members aware, involved and updated on project developments and progress. Not communicating information could impact stakeholder trust, team understanding and morale and lead to ambiguities and delays to the project.
- **Virus Attack:** The various types of approvals are usually secured via computer networks, as it is the quickest way to process the required data. Virus attacks on the company networks could paralyze this process. The alternative is to use conventional methods to obtain approvals, which is more time consuming. The computer system security measures should be reassessed periodically to prevent any system attack, which may impact project activities and project schedule.
- **Travel Distance:** Traveling long distances causes fatigue. Once workers reach the construction sites or the proponent facilities, the proponent may not be available or may be engaged with other workers. The workers may not find anyone to cooperate with them or to certify,

permit or monitor their activities, resulting in no work being conducted. Minimizing travel distances by allocating housing closer to the construction sites and other essential amenities is crucial to improving team productivity.

- **Nature of the Project:** A project involving a new environment, standards, regulations, or employing new technologies is likely to require additional time to explore collected information and data. Few specialists are generally available and there is rarely sufficient knowledge or experience available. This complicates planning, work execution and developing responses or workaround solutions to address risks or uncertainties in the project.

2.7 Proponent and Customer Contribution to Project Delay

Proponent and customer contributions to delay causes include but are not limited to;

- **Expedite Project as a Trade-off Quality:** The project may involve a new system or facility that needs to be brought into operation rapidly. To achieve this, the proponent may accept the system with a number of critical exceptional items, which may require rework, additional cost and more time and cause dissatisfaction and interruption to the service.
- **Data Availability:** The new project may require its deliverables to be interfaced with one or more existing systems. The data for the existing system requires to be obtained from the proponent but it may not be available or updated, and action requires to be taken to collect the data. This process may impact the timeframe for the design stage of the project.
- **Access to Facilities:** Regulations to access facilities depend on the criticality of the facility. Temporary access is an option to enter facilities but it is generally limited to a certain number of people. Work may have to be suspended if teams are stopped from entering the facility as a result of exceeding the visit limits per month. Obtaining company identification cards is not always possible if the area of operation is wide, activities differ in nature, locations are scattered and/or each activity period is short. Obtaining access to facilities may be difficult if they are

located in the desert or the middle of the sea, or if transportation is subject to heavy demand.

2.8 Nature Contribution to Delay

Nature contributions to delay causes include but are not limited to;

- Force Majeure: Force majeure is often a reason for project delay. Natural disasters or extreme weather can damage working facilities in addition to completed works. Areas that are subject to force majeure are at high risk and should be avoided if possible. However, this is not always possible. It is a matter of developing the correct approach and selecting the right tools to design and implement facilities for success. In order to accommodate such risks, construction of civil structures in areas that are subject to earthquake requires appropriate safety and serviceability factors for the structures to be applied to their design and maintained at an acceptable standard. [http://en.wikipedia.org/wiki/Earthquake_engineering],

- Climate: Abnormal weather has its own negative impact on the project schedule. Rain, wind and sandstorms hinder activities, particularly at high elevation locations. High temperature delays activities because it causes fatigue, lack of concentration and stress. Cold weather resulting in snow can block roads, hinder transportation and create obstacles to reaching activity sites.

3. CONCLUSION

This paper has summarized the possible reasons for project delays from eight basic causes or sources of delay, which have been identified as the project management, project team, contract, contractor, safety, organization assets, proponent or customer and Mother Nature. Data from 21 completed and 31 active projects was used to identify and explore these delay causes. However, they can all be correlated with poor or inadequate planning at the start and during the various stages of a project. A brief discussion of each reason for delay has been provided to explain how and why they can lead to project delays.

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Trust and Online Communication in Global Product Development Project

ABSTRACT

The complexity of distributed development projects makes the communication process confused between the interactive networks of stakeholders risks. To solve this problem, this paper builds a Design Structure Matrix to model the communication frequency based on trust among stakeholders and their manifested risks. Furthermore, the paper ranks the most influencing stakeholder with the highest degree of trust. An industrial example is provided to illustrate the proposed model. Results indicated that the trust moderates the communication frequency among distributed stakeholders, even with a higher degree of risks.

Keywords: Trust; Communication; Global Product Development Project; Stakeholders

1. INTRODUCTION

An effective organizational structure of Global Product Development (GPD) architecture makes it easier for teams (e.g., stakeholders) to exchange important information by establishing a coordination mechanism among the most highly interactive teams (Yang et al., 2015; Browning, 2016). In GPD projects, efficient online communication among stakeholders becomes more sophisticated when they perform interdependent activities across spatial barriers (i.e., different locations) and temporal barriers (i.e., different time zones) (Derakhshan et al., 2019; Yang et al., 2015).

Researchers such as Mazur et al. (2014) revealed that behavioral skills and competencies, more specifically Emo-

tional Intelligence (EI), defined as the ability to be aware of, to manage, and to understand emotions in self and others, can affect the outcomes of major projects. Rezvani et al. (2016), for instance, found that managers with high levels of EI are more motivated to be involved in effective communications and are more creative regarding complex tasks, resulting in increased chances of project success in major projects.

Although Rezvani et al. (2016) reported the importance of EI to the achievement of successful outcomes, the project management literature is replete with unsubstantiated generalizations, with much of the existing evidence bearing on the role of EI for project managers. As such, this literature appears to have overlooked the assessment of EI for project team members. Research on the non-project-based organization has shown further that team EI can enhance team members' ability to communicate with one another, to be open to opposing views, ideas, and to use emotion to increase team decision-making and performance (Troth et al., 2012).

While optimizing The Design Structure Matrix Method (DSM) proposed by Steward (1981) is adopted in this study to facilitate the link identification process. Researchers have widely recognized this approach as an efficient tool to depict and assess interrelations among units by using a matrix format (Browning, 2016). This step defines the links in the project risk network relying on trust and communication, which represent the relations between two units. The next section introduces the DSM and how it can be used to analyze stakeholder-associated risks in Online communication. Although many researchers have emphasized the importance of effective communication (Bakens et al., 2005) through em-

pirical studies concerning stakeholder management and relationships in megaprojects (Feige et al., 2011; Lizarralde, 2011), the significance of trust building between government and the public a bottom up approach for stakeholder engagement (Bosher et al., 2009); there have been criticisms that approaches for handling project stakeholders cannot be easily comprehended by construction practitioners (Agle et al., 2008). Problems arising from stakeholder management in major PIC has been discussed by Mok et al. (2015) who found weaknesses in four major research topics; stakeholder interests and influences, stakeholder management process, stakeholder analysis methods and stakeholder engagement.

From this perspective, in light of the conceptual framework, the authors propose that: by focusing on trust benefits realization, the inclusiveness of a broader range of stakeholders in mega projects, as it is in global product development projects, can help to inform the decision making of project managers to achieve a more sustainable development of mega projects at the local level; therefore improving their performance.

2. RESEARCH MODEL: MATERIAL AND METHOD

GPD refers to a project in itself where interactions are highly characterized with complexity and uncertainty (Yang et al., 2015). First, the risk sources in GPD project are analyzed with the identification of associated project stakeholders. Second, the stakeholder-associated risks in the project are viewed as interdependent rather than independent autonomous units. Third, the impact of the risks is quantitatively

calculated based on their communication frequency-related risk. Finally, the interfaces of different project stakeholder groups are analyzed in the DSM.

By identifying the directions of influence in the entire risk, project managers can conduct systemic analysis, communicate with internal and external project stakeholders about the influential risks, and develop risk response or mitigation strategies accordingly. In essence, the application of the DSM perspective to investigate the patterns of stakeholder-associated risk networks as well as the forces which shape these patterns, and unlocks trust interactions inside the project's whole relationship network. All of these are intended to provide a rationale for stakeholder communication and trust response strategies and facilitate the decision-making process in GPD project management.

The dependency strength of distributed teams is defined as the collaborative intensity between teams to cultivate mutual and collective expectations, perceptions, and norms of behavior with their associates while performing common activities. Trust in the stakeholder team can originate from members' beliefs regarding their team. Members are also likely to develop shared notions of trust through continuing collaboration (Gillespie & Mann, 2004). Especially in the context of globally distributed projects, where ambiguity, uncertainty, and interdependency are high, trust is therefore likely to increase the ability of stakeholders to be vulnerable to the actions of another party and to confide in teams to share information and greater cooperation (Stephens & Carmeli, 2016). The Communication Dependency Strength (CDS) between stakeholders is associated with the overlapping process among their communication as expressed in the equation (1).

$$CDS = \ln(\alpha \times T_{ov} \times SCF + 1) + \lambda_0 \quad (1)$$

Where λ_0 represents the degree of inherent communication frequency that is expressed during asynchronous working time. T_{ov} is the overlapping time between the team's activities (Yang et al., 2015). The parameter α represents the trust in teams. We used five items (ordinal variables) interpersonal trust scale developed by Cook and Wall (1980) designed to reflect trust in the team. We used this scale because it is the most widely used measure of interpersonal trust and based on previous studies (Costa & Anderson, 2011; Tsai et al., 2012), that shows good psychometric properties.

SCF is the synchronous communication frequency occurring at the same time due to geographical distance of teams, which is based on eight media assessed: 'Face-to-face', 'Phone or Voice mail', 'Teleconference', 'Email', 'E-room/Network file share', 'NetMeeting', 'Video-conferencing', and 'Instant messaging'. The response scales ranged from 'Never' (1), 'About once a day' (2), 'About 2-3 times per day' (3), 'About 4-5 times per day' (4), to 'Almost continuously' (5). The sum of these eight communication media items was calculated to respond to the total frequency of communication. Higher communication frequency will appear with teams with past experienced teams (Tripathy and Eppinger, 2013).

In particular, we argue that individuals with a high level of emotional intelligence are more likely to trust their colleagues (Sy et al., 2006). Consequently, higher levels of trust should lead to higher levels of communication (Rezvani et al., 2016). Thus, we empirically test a set of theoretically derived equation (1) regarding trust as a motivator of higher dependency strength among virtual teams. Finally, an involvement degree matrix is defined as step 3 of Figure 1 after calculating the relative communication dependency in

Step 2. is defined as the ratio of a stakeholder communication effort to perform activity i to its entire communication effort to perform all activities involved.

An illustrative example at Cevital Group in Algeria was chosen because they present high-level project complexities, which make its stakeholder and risk analysis more meaningful in the environment of trust, due to the complex relationships in the projects, and the project managers has a challenge of managing them. The data were collected by workshops which were organized to identify the internal and external stakeholders and their associated risks in the project. Eight project team members attended the workshop, including project managers, consultant engineer, main contractor, and end users. The workshop participants contributed to the development of a communication strength dependency matrix.

Table 1 is showing the stakeholder's frequency based on their nature of risk in the distributed project with other stakeholders. This table in an input of the DSM matrix to calculate the CDS as shown in step 1 of Figure 1, where 24 stakeholders are identified to perform 46 activities of the project.

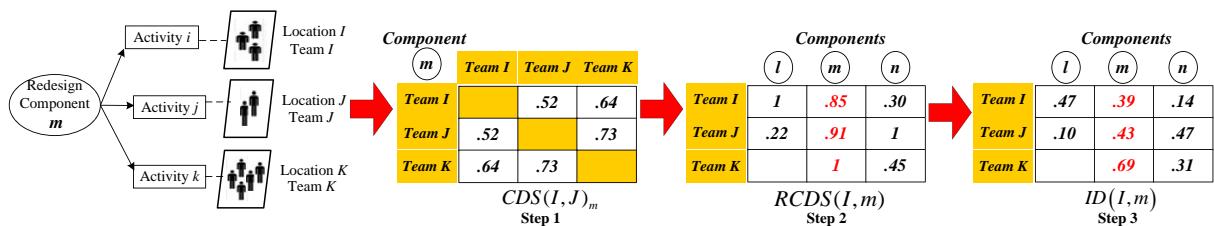


Figure 1. CDS Framework research

Table 1. Summary of risks and stakeholder groups identified in CEVITAL project

Stakeholder category	Stakeholder	Number of risks	Risk category
Client	IBR, IFR, NUMILOG, CANDIA, DANONE, wSOUMMAM	8	Cost Time Quality / technical Environment Ethical / reputation Ethical / reputation Quality / technical Organization and management
Contractor	FTJA	6	Cost Time Quality / technical Environment Safety Quality / technical
Subcontractor and supplier	4 SubcontractorS and supplierS	3	Cost Time Quality / technical
End-user	IBR and its staff	3	Cost Safety Organization and management
Government	Local government for building approval	1	Policy and standards
	Local government for green certificate approval	1	Policy and standards
Communities	Green building committee	1	Ethical / reputation
Competitors	2 Other consultants	2	Quality / technical Environment
Assessors / certifiers	8 Assessors / certifiers	1	Ethical / reputation

3. RESULTS AND DISCUSSION

The result of the matrix below could provide the project manager with an appreciation of how a stakeholder is influencing the activities. In fact, the number of performed teams resulting from the communication exchanged and the higher level of trust with other stakeholders shows the more integrated risks by a stakeholder. In this case, the stakeholder G is the most influencing, because it shares a larger number of activities which are geographically distributed.

Illustrating stakeholder management practices and correlated benefits at the geographical level of GPD projects will

offer practitioners the opportunity to increase public support with higher trust and reduce local opposition to megaprojects.

By evaluating the practical implications of including secondary stakeholders' inputs in the decision making process during the initiation phase of major design project as it is with CEVITAL Group, effective stakeholder management approaches could be developed to enhance project performance.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46		
A	0.1	0.6																																								0.2						
B	0.2																0.4	0.4																														
C																			0.5																													
D	0.5																			0.4																								0.1				
E			0.6																																													
F																																																
G	0.1		0.1		0.1														0.4																					0.1								
H																																																
I	0.5																																										0.2					
J					0.5														0.5																													
K																																																
L		0.5	0.5																																													
M							0.6																																					0.4				
N		0.3				0.2													0.1	0.3																						0.1						
O																																																
P																																													0.2			
Q			0.4																																									0.2		0.4		
R								1																																								
S									0.3																																			0.3		0.1		
T																																													0.1		0.3	
U																																													0.3		0.1	
V																																													0.1		0.1	
W																			0.3																									0.7				

Figure 2. The involvement degree of stakeholder-activities of CEVITAL Group

Figure 3 shows the status centrality map in the GPD project. The risk impacts decrease along with the distance between the Online communication relying on trust (node) and the center of the circle.



Figure 3. The status centrality map in the GPD project

It also shows that ‘assessment experience and fairness’ is a critical risk with consideration of propagating effects in the network. This supported the client and government within ‘quality/technical,’ ‘policy and standards,’ and ‘organization and management’ risk categories having a higher impact within the network, respectively. Finding in ID matrix is used to implement the centrality as team’s mindset regarding their trust while performing their activities.

From a practical standpoint, firms interested in enhancing the novelty of their innovations should create teams with varied knowledge and skills. However, managers must note that having heterogeneous stakeholders with access to different information networks to reduce project's risks is not sufficient. They may offer knowledge not currently available to a firm, but they rarely can translate this knowledge into innovative outcomes through this path alone. To exploit the knowledge and skills of a team, members must be able and motivated to trust each other and share their unique knowledge without undue influence from status hierarchies. For firms to benefit from their human capital in general and the informational diversity of their members in particular, they need to align these resources with the social structures that facilitate knowledge sharing and mutual understanding.

4. CONCLUSION

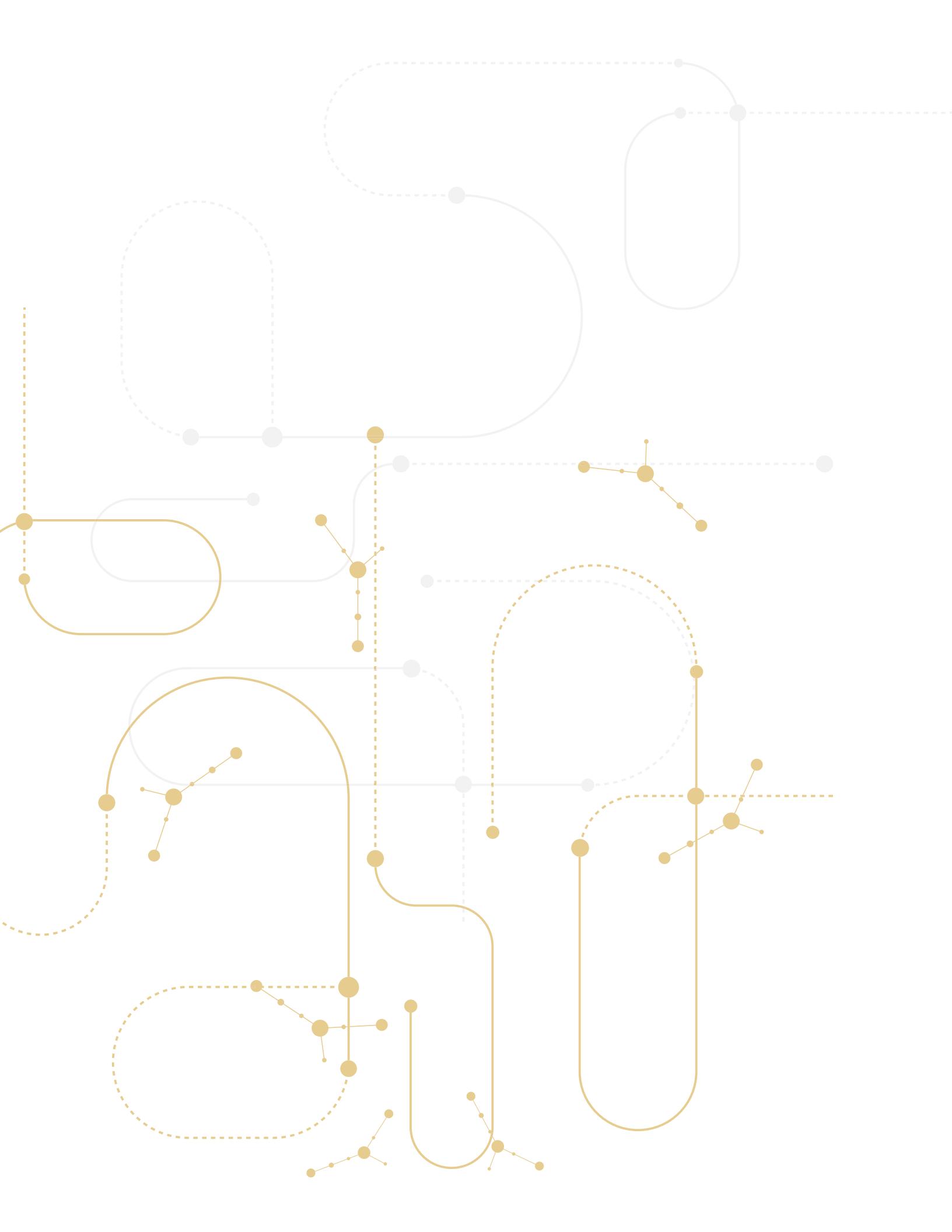
GPD projects have been classified as challenging relationships among project stakeholders and high productivity (Thripathy and Eppinger, 2013; Yang et al., 2015; Wu et al., 2017, Rezvani et al., 2018). Thus, it is theoretically and practically significant to examine the influence of soft factors, more specifically trust interactions between project stakeholders at a communication and coordination level simulta-

neously. This study answered the calls for a multi-level study of trust and developed a research model that simultaneously analyzed and advanced the multilevel influence of trust (Gupta et al., 2016), and risk networks (Yang and Shen, 2015; Nguyen et al., 2019).

To provide an effective tool for practitioners and to address the current limitations in practice, a stakeholder model, based on empirical studies, will be proposed in future research. The model should attempt to incorporate both the social impact of major construction projects on secondary stakeholders and the views of primary stakeholders essential to organization survival. Ideally, the model would generate qualitative data from capturing and clarifying the views and accountability of primary and secondary stakeholders at each stage of the project life cycle. Using such a model will aid construction project managers and project promoters in ensuring that their projects were successful and welcomed by the local community, therefore achieving sustainable development through a management-for-stakeholder approach and enhancing trust attitude. There is a need for a tailored stakeholder analysis model to help the project manager and project team seek 'win-win' solutions rather than accept trade-offs for better transparency and accountability in project decision making and benefits realization.

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Student Competences in the Field of Project Management

ABSTRACT

The aim of the article is to present competences held by people certified by the IPMA-Student Portal. The study has been based on the literature analysis of the subject, as well as on the analysis of data obtained from electronic examination portal – IPMA Student.

The main result of the analysis is:

- identification of competences in the field of project management, which certified students have. Research show that the level of competence held by students in individual years varies in the majority of the analysed competence elements.
- showing strong and week sides of a student competencies. Analysis show that the best results students get in the area of behavioural competences, slightly worse in the area of technical competence, and the weakest in the contextual competences.

The conclusions obtained have a practical importance, because they allow identification of competences within the field of project management that need to be developed by students. Undertaking the subject, it allows to signal the importance of the competences in the field of project management among students.

Keywords: Competences; Project Management; Certification; Student Competences

1. DEFINITION OF COMPETENCES

The concept of competence has been repeatedly defined and the multitude of definitions means that the concept is complex, especially with regard to its adaptability to be defined and used in economic practice. Most of the definitions refer mainly to the issues related to the effectiveness of the use of human capital of the organization, defining competences as the basis for the management of human resources. R. Boyatzis (1982) defined competences as the dispositions of a given person, which leads to behaviors consistent with the requirements of the workplace defined by parameters of the organisational environment, which, in turn, brings the desired results (Amstrong, 2011, p. 190).

R. Ranking (2002) refers to competence in relation to employee performance, indicating that it is used to determine the expected results of a given person's performance, as well as the way of performing tasks, and that competence may serve as a common, commonly understood way of describing expected work performance.

The main question is which competences are the most, and which least developed. Answers to this question will help educational system to eliminate competence gaps among future employees entering the labour market. It is important not only for Universities, to create good education offer, but also for all organizations operating on the labour market, who will hire young people in the future Standish Group (2015).

1.1 Project management competence

Project management is one of the most dynamically developing areas of management. Effective project implementation depends on both the technical aspects of execution and the competence of people implementing a given project. Individual competences of project managers and their team members are one of the basic factors determining the success of a project. Therefore, project management competences have become an area of interest for both theoreticians and practitioners.

Individual competences are not permanent, they are subject to change over time as a result of learning processes, accumulated experience and increased proficiency in performing tasks. They are closely related to the employee's career development and are therefore subject to evaluation (Dainty A...2005, Al-Emranab A...2016). This assessment is possible thanks to the adoption of specific standards characterizing particular levels of competence.

In the area of project management competence standards, two most recognizable models can be distinguished. These are:

- IPMA Competence Baseline – a competence model of a project manager, created by the International Project Management Association,
- Project Manager Competency Development Framework – competence model by the American Project Management Institute.

In this publication, due to the identified levels of competence development and their structure, an attempt has been made to relate particular levels of competence according to ICB to a model of competence development.

1.2 The IPMA International Competence Model

The International Project Management Association (IPMA) is an international non-profit organization that brings together national associations in the field of project management in 72 countries around the world. Its mission is to create a global space for activities that shape the future of project management. The main goal of the association is to build a platform for the exchange of experience in project

management and to create professional and ethical standards for project managers.

The basic result of these activities is a developed and regularly updated framework document, the so-called IPMA Competence Baseline (ICB), which presents the definitions of individual competences that are necessary for effective project management. ICB is the result of the work of teams of specialists, scientists and project management practitioners associated in national associations.

ICB is a comprehensive list of competences that a person must have or develop in order to effectively implement projects. The general model is applied in all sectors and industries. This means that appropriate methods and tools can be defined by the organisation and an individual should select the appropriate components from a wide range of available methodologies, techniques and tools that may be used or fitted to the specific situation. Of course, the importance of the individual competencies needed to successfully implement projects depends on the type of projects (e.g. IT, manufacturing, research and development) and industry (e.g. construction, business and administration services) and the level of complexity.

The IPMA Competence Guidelines distinguish 3 areas of competence (ICB IPMA, 2006):

- Technical competence includes the basic elements of competence in project management, which are at the heart of professional project management, sometimes referred to as hardcore elements.
- Behavioural competence area includes personal competence elements in project management, in particular the attitude and behavior of a project manager, its elements are sometimes referred to as "soft".
- Contextual competence includes elements relating to the project context, in particular the organisation's strategy, the relationship between the project and operational activity, the relationship of the project manager and the project management team with the line management and business management of the organisation, and to functioning within a project, programme and portfolio oriented organisation.

Each competence element in each area is defined by a name, content description, list of topics covered, list of possible actions, key competences required for each of the four levels of IPMA certification, key terms and key relations with other competence elements.

The IPMA Competence Guidelines form the basis for certification, run by the certification bodies of the member associations.

1.3 IPMA-Student Competence model

The IPMA certification system (IPMA 4-L-C) gives foundation for continuous improvement and development of project manager competences. Subsequent levels of certification are milestones in an individual's professional career, and are used by organizations in recruitment processes, developing career paths of employees and building project maturity of the organization.

The universal and transparent model of competence requirements, developed by IPMA in cooperation with the academic and business communities, taking into account the best practices and needs of the labour market, provides the basis for universities to adapt and develop their curricula (IPMA-Student accreditation system). The IPMA Student certification system based on it increases the chances of students on the labour market (IPMA Student certificate), and for entrepreneurs it is a confirmation of the candidate's competence. The use of the model gives universities the opportunity to identify the competence gap and take action to reduce it.

- Knowledge (knowledge of terms, definitions, models, facts, criteria, standards, methods, processes, relationships);
- Understanding (ability to interpret terms, definitions, models, facts, criteria, standards, methods, processes, relationships);
- Skills – The application of “simple” (for a specific scenario, recognition and use of a proper method, technique and tools, interpretation of results, conclusions);
- Skills – “Complex” application (for a specific scenario, combining different areas and criteria, choosing the right

method, techniques and tools, interpreting the results and choosing the best solution) – level not required for IPMA Student certification.

The competence requirements of IPMA-Student IPMA Poland were developed in the format binding in the European higher education (in Poland the guidelines of the National Qualification Framework for higher education). The basis for the university's accreditation is the IPMA Student Competence Matrix, which confirms the compliance of the subjective effects of the courses offered by the university with the effects of IPMA Student's training.

The implementation of the IPMA Student Model at universities is confirmed by granting of IPMA Student accreditation. The process of obtaining accreditation is based on preparation and description of a didactic path in the field of project management at a given university. The basis for accreditation is filling in the so-called Competence Matrix together with the Cards of subjects included in the accredited classes. The matrix presents connections between IPMA-Student and the subject matter of university education. The required number of teaching hours conducted with the participation of academic teacher is 60 hours for full-time studies and 30 hours for part-time studies. Accredited universities have the possibility to use didactic materials developed by IPMA (competence quizzes) during the implementation of activities covered by IPMA-Student accreditation.

Students who pass the accredited course path have the right to take the IPMA-Student certification exam.

The programme has been in operation since 2014, has been implemented in 25 universities in Poland, so there are already grounds for verifying the effectiveness of student education using the model.

It is worth noting that among the universities that have obtained IPMA-Student accreditation, apart from those that have only confirmed the compliance of their curricula with the requirements of IPMA Student, there are also those that have launched new curricula based on IPMA Student's educational results.

The development of the IPMA-Student certification programme is based on a periodical analysis of requirements concerning project management positions and practices,

as well as requirements and conditions of higher education. The analysis is carried out by the Programme Committee for Certification at least once every five years.

1.4 IPMA-Student Certification Examinations

The IPMA Student certification exam is conducted on paper and online, in accredited computer labs under supervision of an IPMA Student Coordinator. The scope of the examination covers all competences of the IPMA Student model.

The exam is available only for students and graduates admitted by IPMA Polska CERT, i.e. those who have been registered by the accredited Faculty as entitled to apply for IPMA-Student certification (they have passed the path of accredited subjects) and have paid certification fee to IPMA Polska.

The examination consists of 100 questions, including 70 in the area of technical competence, 15 in the area of behavioural competence and 15 in the area of contextual competence. The format of multi-choice questions is the same as in quizzes. Exam time limit: 100 min.

Passing rate of the Test is minimum 50% of total points. Passing the Test is not a prerequisite for taking the IPMA Student certification exam.

2. STUDENTS COMPETENCIES IN THE FIELD OF PROJECT MANAGEMENT, BASED ON THE IPMA-STUDENT E-EXAM

2.1 Method and research sample

The examination of students competencies in the field of project management was carried out on the basis of data obtained from the electronic examination platform – IPMA-Student portal. The study was made using a statistical method involving MS Excel 2016 software.

The research sample includes students of accredited universities¹ who took the IPMA-Student certification exam

in an electronic version in the period: March 2015 to April 2019. These are not all certified persons, due to the fact that some universities use a paper version of the exam. Students included in this research are studying in various fields, as well as specializations, not only related to management, they are both first and second cycle students. In total, in the analyzed period 452 students approached the exam in electronic form.

2.2 Analysis of the results of the IPMA-Student exams

Analysis of the IPMA-Student exam results covered 452 approaches that were carried out in years 2015-2019. The largest group of students took the exam in year 2018, it was 207 students. Both the average rating and the median of the results in the analyzed years fluctuate around 60%. The highest average grade obtained by students in year 2017 was 62%, while the lowest in 2015 – 58%. The highest median, in the amount of 62%, was in year 2018, and the lowest in 2016 (57%). In all analyzed years there is a relatively low variation in the results, which is confirmed by the size of the calculated standard deviation (Table 1). The exact results of the analysis of the IPMA-Student e-exam by year are presented in Table 1.

The analysis of the results obtained by students allowed to indicate the minimum and maximum result achieved by students in the analyzed period. Out of 100 points to be earned, the lowest score of 36 points was obtained by a student in year 2018, and the highest score of 84 points was obtained in year 2015. The distribution of results in individual years and in total is presented in Figure 1. Median and average value were the same in year 2015 and in the case of the entire analyzed period, which indicates the symmetry of the distribution. However, in the other analyzed years, these values differ slightly, which can also be seen in the distribution of results of the IPMA-Student exams.

1 The university receives accreditation based on the completed “Competence Matrix”, which shows the links between the

effects of IPMA-Student education and the subject learning outcomes of the university. The education programs of accredited universities must include content related to education in the area of project management, at the level enabling students to acquire competences in the field of project management.

Table 1. Results of IPMA-Student exams in years 2015-2019 (source: own study)

	2015	2016	2017	2018	I qr 2019	All
The total number of approaches	69	35	52	207	89	452
Average rating of all approaches	58%	59%	62%	61%	61%	61%
Median	58%	57%	60%	62%	60%	61%
Standard deviation	10%	9%	9%	9%	8%	9%
Asymmetry factor (Skewness)	0,41	0,1	-0,14	-0,25	-0,09	-0,08
Kurtosis	0,14	-0,21	-0,26	-0,27	0,21	-0,23

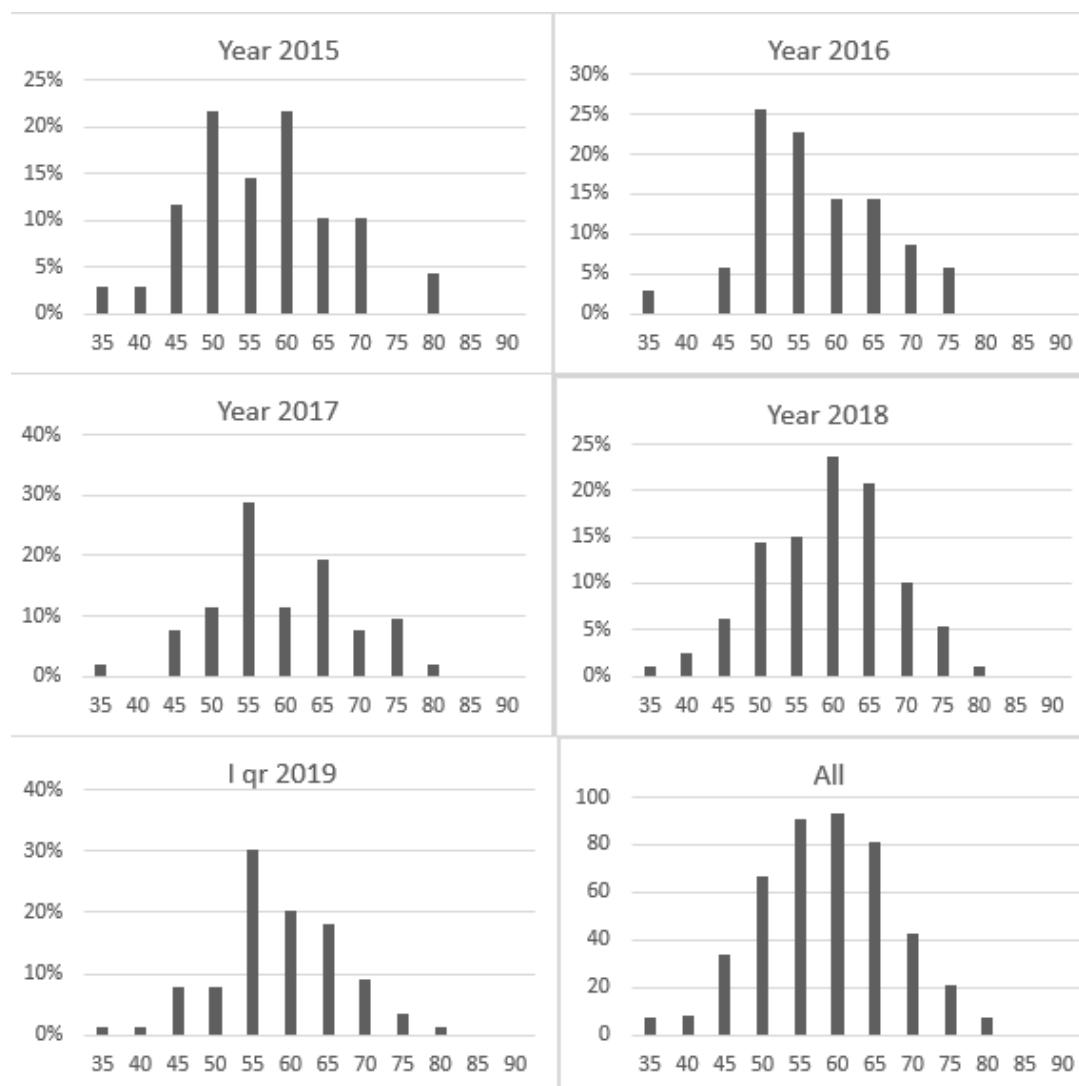


Figure 1. Distribution of results of the IPMA-Student e-exam in the analyzed years (source: own study)

The IPMA-Student certification covers three key areas of competence in the field of project management. Analysis of responses in individual areas allows to indicate which of them are students' strength, as well as those in which students have not demonstrated sufficient knowledge. Figure 2 presents the percentage of correct answers that students gave in individual areas of IPMA competences, divided into the analyzed years.

The analysis of answers in the area of technical competence indicates that students have the greatest knowledge in the field of communication (80.71% of correct answers) and problem solving (79.95%). Analysis of responses in individual years showed that in year 2015 students gave the most correct answers in the field of problem solving (86.67%), while in 2016–2019 it was communication (82%–84%). On the other hand, the least correct answers were given by stu-

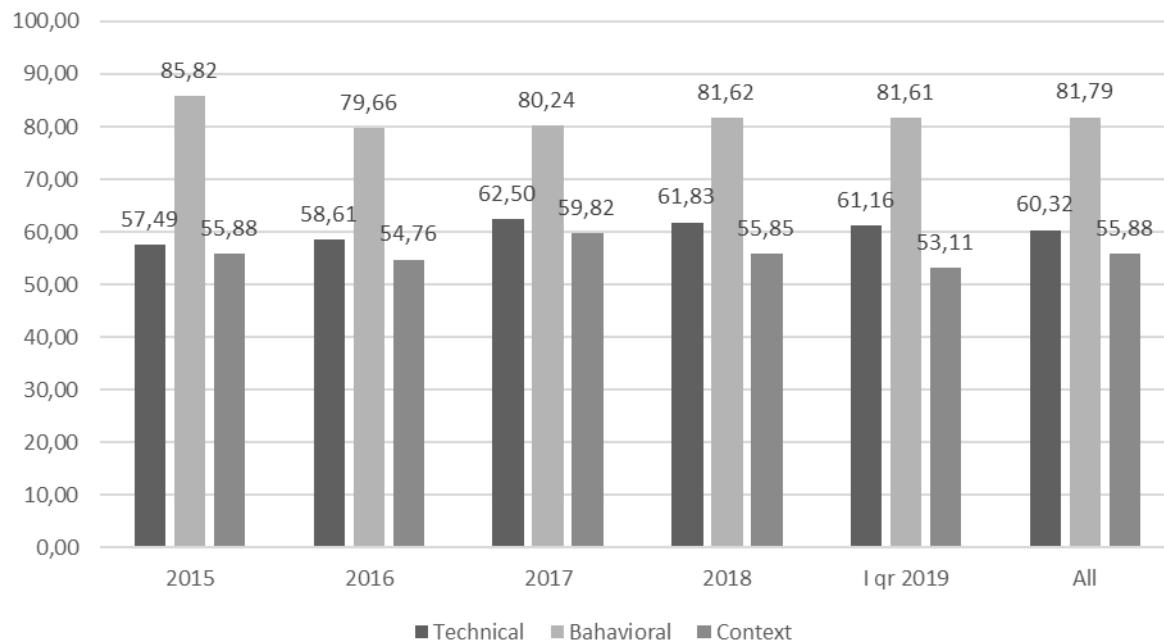


Figure 2. Percentage of correct answers to questions in individual areas of IPMA competence in the analyzed years (source: own study)

The analysis of the data presented in Figure 2 clearly indicates that behavioral competences are statistically significantly better than competences in other areas. Students obtained the worst results in context competences, regardless of the year under study. The lowest level of contextual competences may be due to students' lower practical experience.

dents in 2015 in the field of project start-up (only 18.84%), while in the remaining years these were competences related to risk: threats and opportunities (33%–39%). At the same time, both elements of technical competence are distinguished by the lowest level of familiarity among students in the analyzed years. Detailed information on correct answers in individual elements of technical competence is presented in Table 2.

Table 2. Average percentage of correct answers in the area of technical competences in the IPMA-Student e-exam (source: own study)

Competence Element	2015	2016	2017	2018	I qr 2019	All
1.01 Success of project management	37,32	48,57	65,38	68,60	69,44	57,86
1.02 Stakeholders	75,36	78,57	71,15	70,85	71,91	73,57
1.03 Project requirements and goals	68,84	71,43	67,95	66,99	62,55	67,55
1.04 Risk: threats and opportunities	32,61	39,52	37,18	33,17	35,58	35,61
1.05 Quality	72,46	55,71	49,52	45,53	42,70	53,19
1.06 Organization of the project	49,28	53,88	66,15	67,25	66,52	60,61
1.07 Teamwork	63,29	55,24	55,77	56,14	63,82	58,85
1.08 Problem solving	86,67	78,86	78,85	82,37	73,03	79,95
1.09 Project structures	57,49	57,14	61,54	51,69	56,18	56,81
1.10 Scope and sub-products	64,49	52,86	51,15	48,89	48,09	53,10
1.11 Time and stages (phases) of the project	39,28	45,71	43,46	46,91	42,13	43,50
1.12 Resources	53,62	52,14	67,31	62,96	64,79	60,17
1.13 Costs and financial resources	67,87	66,67	67,31	69,15	67,90	67,78
1.15 Changes	68,12	50,00	65,38	63,77	56,18	60,69
1.16 Control and reports	55,07	57,14	69,23	72,27	73,48	65,44
1.18 Communication	66,67	87,14	82,69	82,77	84,27	80,71
1.19 Start-up	18,84	45,71	-	-	-	32,28

Analysis of responses in the area of behavioural competences allows to indicate the elements of competences that are at the highest and lowest level among students who took IPMA-Student e-exam. The results differ in the analyzed years. The best results in year 2015 (100%), students obtained in subjects of assertiveness and value appreciation. Assertiveness was also the best considered element in year 2018, while value appreciation in year 2016. Years 2017 and

2019 is the highest passivity in subjects of engagement and motivation (about 97%). The weakest results were obtained by students in the area of leadership (59,24%) and conflicts and crises (61,83%). At the same time, the least-rated competences were: leadership in years 2015-2016, and conflicts and crises in years 2017-2019. Precise data on correct answers in individual elements of behavioural competences is presented in Table 3.

Table 3. The average percentage of correct answers in the area of behavioural competences in the IPMA-Student e-exam (source: own study)

Competence Element	2015	2016	2017	2018	I qr 2019	All
2.01 Leadership	55,56	66,67	55,13	57,81	61,05	59,24
2.02 Engagement and motivation	73,19	78,57	97,12	95,17	96,63	88,13
2.04 Assertiveness	100,00	82,86	92,31	96,14	93,26	92,91
2.07 Creativity	-	-	75,64	74,56	71,16	73,79
2.08 Results orientation	91,30	85,71	84,62	93,72	94,38	89,95
2.12 Conflicts and crisis	83,57	66,67	48,08	55,80	55,06	61,83
2.13 Reliability	97,10	80,00	90,38	89,86	86,52	88,77
2.14 Values appreciation	100,00	97,14	88,46	80,19	80,90	89,34
2.15 Ethics	-	-	90,38	91,30	95,51	92,40

In the area of contextual competences, the best-developed element is human resources management, both in individual analyzed years and in total in the analyzed period. The least developed competences concern the orientation on projects and permanent organizational structures. Detailed data on correct answers in individual elements of contextual competences is presented in Table 4.

Table 4. The average percentage of correct answers in the area of context competences on the IPMA – Student e-exam. (source: own study)

Competence Element	2015	2016	2017	2018	I qr 2019	All
3.01 Project orientation	59,42	53,33	54,33	50,24	48,03	53,07
3.05 Permanent organization	42,51	53,81	53,21	52,58	49,06	50,23
3.08 Personnel management	65,70	57,14	71,92	64,73	62,25	64,35

The above analysis of competence elements allows to indicate which areas should be strengthened in the future among students, and which could remain at the current level. However, it should be noted that the examination set consisting of 100 questions, in accordance with the competence requirements of IPMA-Student, includes 70 questions on technical competence, 15 questions – behavioural competences and 15 questions – contextual competences.

3. SUMMARY

Competences are an important asset in today's world. Thanks to them, enterprises can grow and operate effectively on the market. They allow to match a specific person to the right job, so that both parties (employee and employer) get satisfaction from the job. And it is thanks to them that enterprises and also specific sectors of the economy can develop, creating a dynamically developing labour market. That is why it is extremely important to develop competences of young people entering the labor market.

The research presented in the article was carried out on a sample of 452 students of Polish universities that have approached the certification on the IPMA-Student electronic platform. The analysis was made on the basis of actually carried out examinations, which indicates a high level of objectivity of the data presented in the article. The results of the analysis indicate that:

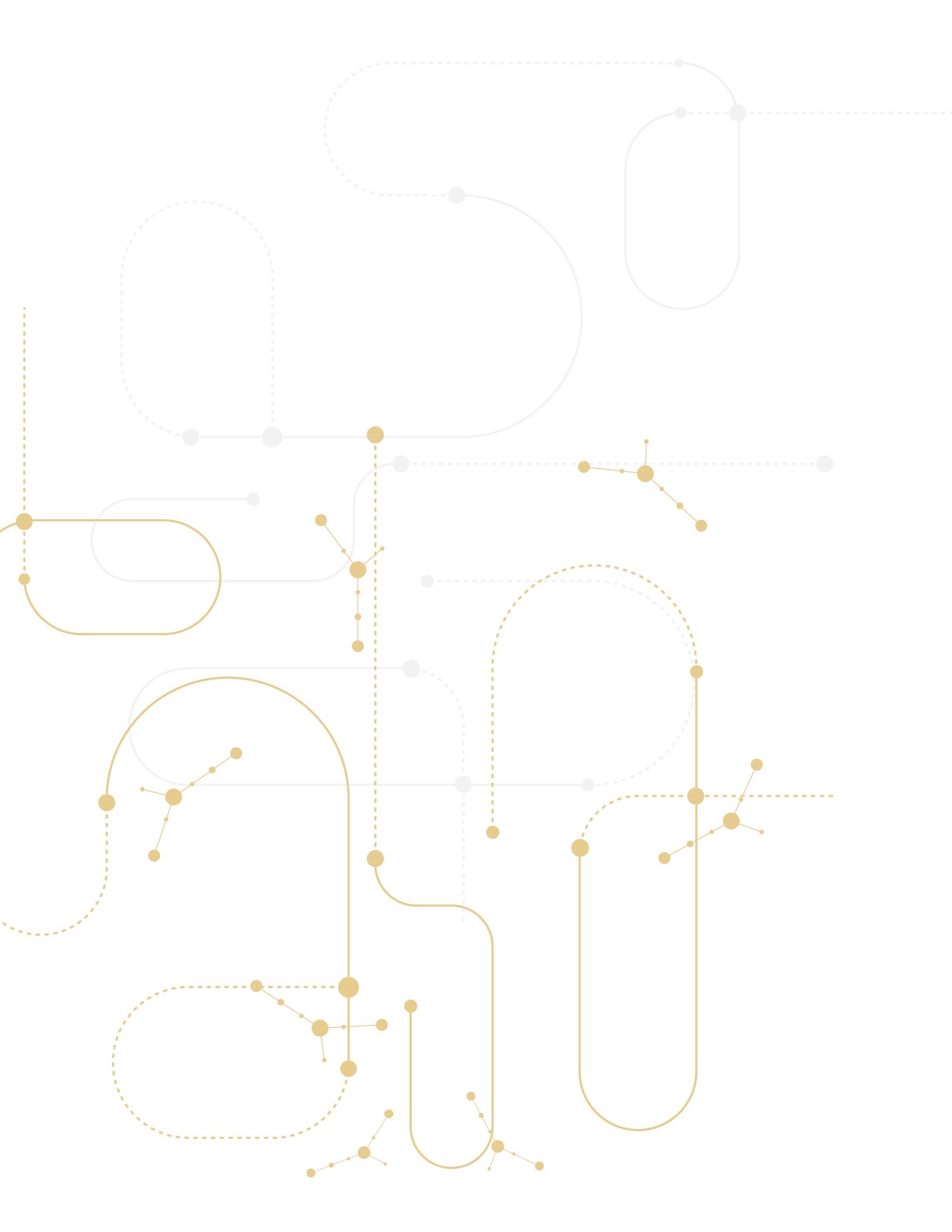
- students of accredited universities, regardless of the analyzed year, obtained the best results in the area of behavioural competences, slightly worse in the area of technical competence, and the weakest in the contextual competences,
- all elements of behavioural competences, both in particular years and throughout the analyzed period, are developed at a high level above 50% (pass threshold for IPMA-Student),

- the level of competence held by students in individual years varies in the majority of the analyzed competence elements,
- in the area of technical competence, students' strength is communication and problem solving competences that are possessed at a high level, while their weakness is in the competences associated with risk,
- in the area of behavioural competences, students in each analyzed year showed a high level, the highest were: assertiveness, values appreciation and engagement and motivation,
- in the area of contextual competences, students' strength are competences in personnel management, while project orientation and permanent organization are on a variable level oscillating around 50%.

The analysis of students' competences in individual years is necessary to emphasize the development of specific competences among students studying at Polish universities. Properly selected education system will allow to eliminate competence gaps among future employees entering the labour market. The authors plan to continue research among students to study their further professional career. The future study will allow to identify the competences within the field of project management that have a key impact on a professional career.

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Success Factors For Exploiting Opportunities In Projects And The Requirement Of Trust

ABSTRACT

In projects, the (structured) identification and handling of threats that could endanger the project goals is extremely important. Project risk management provides methods and tools for this purpose. According to the theory, however, not only threats but also opportunities should be in focus in project risk management. In recent research, there is disagreement whether this makes sense or not. In practice, opportunities are rarely managed in a structured way and are usually sought when project goals are in danger. For the identification and exploitation of opportunities in projects, not only a structured approach, appropriate methods and tools are important, but also human factors and factors that influence the work in projects. This article shows which preconditions are important for exploiting opportunities in projects and why trust plays a role therefore. The presented research is based on meta-analyses by authors who compiled factors that promote creativity and innovation on the one hand and success factors for project management on the other. These factors were analysed in terms of dealing with opportunities in projects and discussed in an expert group. As a result, we developed eight clusters with success factors and present measures in this paper to meet the pre-conditions in organisations.

Keywords: Opportunity Management; Risk Management, Uncertainty, Trust

1. INTRODUCTION

Due to factors such as globalisation, dynamic markets, or high competitive pressure, it should become increasingly important for companies in many industries to gain competitive advantages and to create values beyond the defined project goals in order to increase the success of the company. Therefore, it is indispensable to exploit opportunities in projects. In literature, there is more or less agreement on how project opportunities are defined: Project opportunities are possible positive deviations from the project objectives (e.g. PMBOK, 2017). However, there is disagreement how this term relates to the concept of risk. This observation can be demonstrated by the following two approaches: While in the Individual Competence Baseline ICB 4 (2015) of IPMA risks are defined as threats to the project distinguishing between risks and opportunities, in the PMBOK Guide (2017) of PMI risks are seen as both, threats and opportunities. However, regardless of which approach is followed, it can be said that the topic of project opportunities is integrated into the project management standards. Therefore, opportunities should be identified and treated in projects. The question that has not yet been fully understood, however, is which preconditions have to be fulfilled in order to exploit opportunities in projects and what concrete measures have to be taken in projects and organisations.

2. LITERATURE REVIEW ON OPPORTUNITY MANAGEMENT IN PROJECTS

The relationship between risk management in projects, uncertainties and opportunities has been the subject of discussion in several publications. The following review is intended to give a brief overview of the findings and publications of some researchers from 2001 onwards.

One of the first, who suggest improving the risk management process to exploit opportunities in projects was Jaafari (2001). One year later, Hillson (2002) published a proposition on how to deal with opportunities in projects. He suggests not to develop a separate process for managing opportunities, but to extend the risk management process in such a way that opportunities can be dealt with. In 2003, Ward (2003) argues that the term 'risk' has negative connotations and is associated with an event rather than sources of uncertainty. This would lead to a restricted focus on threats in project risk management. In order to enhance project risk management which also includes an enhanced focus on opportunities, it is necessary to understand and manage all project uncertainties. Besides other activities, he suggests to use the phrase 'project uncertainty management' instead of 'project risk management'. In 2007, by means of a case study, Olsson (2007) found empirical evidence that risk management in projects mostly focuses on threats rather than opportunities. The case study was based on interviews with eight project management professionals from different industries. It is shown that opportunities are increasingly identified in the sales phase of a project. During the execution phase, the focus is on threats and the exploitation of opportunities depends on the project manager or project requirements. It is argued that one reason is that opportunities could not fully be managed by existing risk management processes. In 2012, Lechler et al. (2012) conducted an exploratory study in which the relationship between uncertainties and opportunities, and the relationship between exploited opportunities and achieved project value were analysed. The results show that opportunities are connected with at least one situation of uncertainty. The reverse case, however, in which each identified uncertainty led to at least one opportunity, is not valid. In addition, the results indicate that exploiting opportunities has a beneficial impact on the project and performance criteria, such as schedule,

stakeholder satisfaction etc. Based on their observations in the study, Lechler et al. presented four propositions:

"Proposition 1: Opportunity could be discovered or created from uncertainties in project settings."

"Proposition 2: Project managers who can perceive uncertainties have a higher likelihood to discover and explore opportunities."

"Proposition 3: Project managers with a business-oriented mindset are more likely to identify opportunities."

"Proposition 4: The exploitation of opportunities in project settings is beneficial for project value."

In 2014, Krane et al. (2014) published the results of two case studies. Since in theory, uncertainty management should deal with both threats and opportunities, and some authors argue that there is no need for a separate process, Krane et al. assume that if this is the case, it should be reflected in the registers of uncertainty and risk management. The study examined risk registers in seven projects in a private company in the energy sector and in five projects in the public sector. The results suggest that the focus in uncertainty management is still on threats and that only few or no opportunities are dealt with in the execution phase. Opportunities are only actively sought when there is a feeling of insufficient budget in the project. In 2016, Johansen et al. (2016) developed a theoretical explanation model that explains why only few opportunities are exploited in projects and what the barriers are. According to his research, opportunities must be very interesting, because contracts may need to be modified and the project must abandon a previously best solution. According to Johansen et al., barriers for pursuing opportunities are:

- "Losses in value and time from the work of that project that has already been done, since this had to be abandoned"
- "A need to spend time and effort on determining the value of the opportunity"
- "A need to spend time and effort on re-planning the work to the same level of detail as the existing plan"

- “Uncertainty as to whether the new opportunity will succeed and who will share the additional value and benefit”

In summary of this short literature review on opportunity management in projects, it can be said that

- there is disagreement and a different understanding concerning the relationship between opportunities and the concept of risk and how to deal with opportunities
- the focus in projects is on dealing with threats and that opportunities are usually identified during the sales phase or when there is a feeling of insufficient budget or a deviation from the project plan.
- barriers exist pursuing opportunities in projects
- the project manager seems to play a central role for exploiting opportunities in projects.

3. RESEARCH DESIGN AND METHODOLOGY

The aim of the presented research is to examine the success factors and preconditions for opportunity management in projects. The consideration is not restricted to specific project types or industries. It is rather a broad study of the pre-conditions and success factors for identifying and managing opportunities in projects. The examination is based on four pillars, which are shown in Figure 1. The first pillar comprises findings from literature. The second pillar contains the results of a conference held by the Chair of Project Management at the University of Kassel in 2017. These first two pillars form the basis for the expert group, which is the third pillar. The fourth pillar comprises the validation and results of a number of expert interviews. The different pillars are described in the following subchapters.

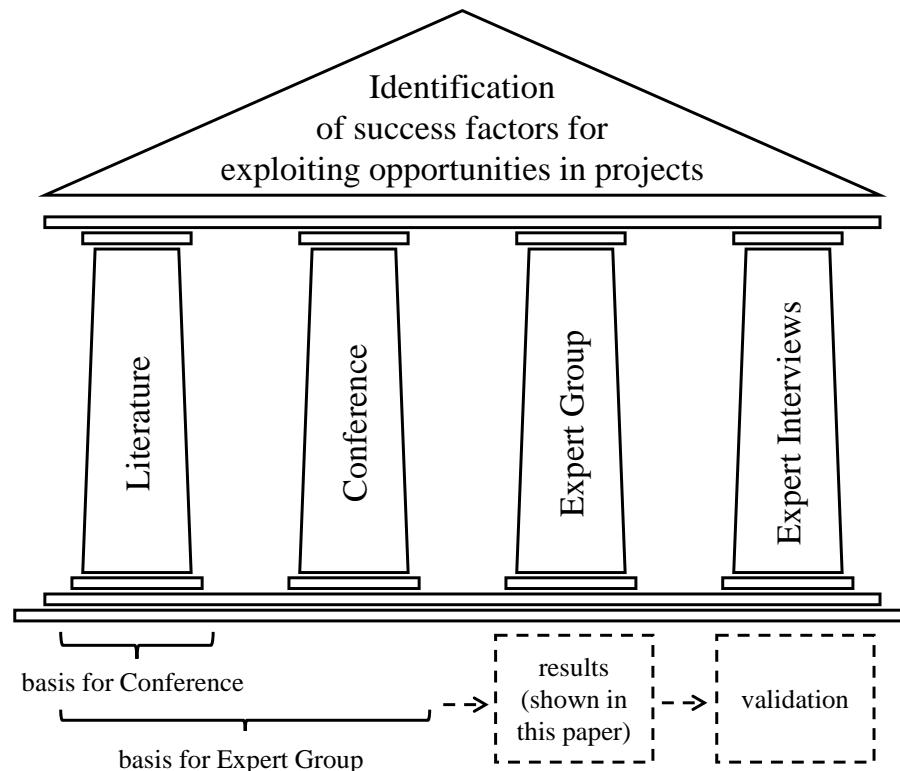


Figure 1. The four pillars of this research design

3.1 Literature

There is already much literature on the subject of success factors. However, there is no comprehensive literature on what the preconditions and success factors are for identifying and dealing with opportunities in projects and how these preconditions can be operationalised in organisations. In order to achieve the aim of this research, literature on success factors related to project management and innovation is used as basis. For the use of literature on innovation, we argue that opportunities and innovations have similar characteristics: Both require creativity (Lechler et al., 2012; Anderson et al., 2018)), initiative to identify and realize them (Johansen et al., 2014; Hauschildt et al., 2016) and at the time of the decision for pursuit, it is not certain whether success will occur or not (PMBOK, 2017; Hauschildt et al., 2016).

3.2 Conference

For our research purposes, we organised the 8th Kassel Project Management Symposium (Spang and Singer, 2017) as a mixed conference and workshop event. A total of around 60 experts took part, mainly from the construction industry, automotive industry, medical technology industry and project management consulting. The event was divided into three periods: In the first period, six short presentations were held by leading practitioners from the industry to give some impetus for the subsequent workshops. In the second period, five parallel workshops were held with eight to eight-

een persons each. Each workshop had two to three specific questions prepared by us and each workshop was accompanied by a moderator, supported by an assistant. In the third period, the results of the workshops were presented and discussed with all participants in the plenum.

3.3 Expert Group

The expert group was developed as a variation of a focus group subsequent to the symposium. In the selection process, care was taken to ensure that participants were really interested in the topic, had sufficient professional experience, held management positions in their companies and came from various backgrounds in order to include different perspectives in the discussions. As can be seen from table 1, the group consists of seven experts from industry: a managing director of a construction company, a managing director of a consulting company, a construction director of a railway electrification company, a vice-head of project management of a logistics company, a review director of an oil and gas company, and two regional directors of project consulting companies. In addition to these experts, the two authors of this article are part of the group, too. This results in a total of nine people in the group. The working method follows a structured procedure and is characterised by a regular meeting rhythm in which telephone meetings alternate with attendance appointments. Topic questions are worked on by each individual up to each appointment and the contributions are discussed in the group.

Table 1. Composition of the expert group (excluding the both authors of this paper)

Experts	Position	Project experience	Industry	Company size (staff)
Expert 1	managing director	> 20 years	construction	> 5000
Expert 2	managing director	> 20 years	consulting	> 500
Expert 3	construction director	> 15 years	railway infrastructure	> 500
Expert 4	vice-head of project management	> 5 years	logistics	> 2500
Expert 5	review director	> 20 years	energy	> 2500
Expert 6	regional director	> 10 years	project consulting	> 250
Expert 7	regional director	> 5 years	project consulting	> 25

3.4 Expert Interviews

In order to validate the results and to gain insights beyond the expert group (e.g. comparison of industries), 15 to 20 further experts, also from various industries, are interviewed individually. For this purpose, we use the method of semi-structured interviews, which are evaluated with the help of a qualitative content analysis. In this article we present the results of the expert group. Therefore, the method of the expert interviews is not described in detail.

4. RESULTS

4.1 Literature

The literature research on preconditions and success factors was carried out not only in the area of project management, but also in the area of innovation and creativity. We argue that opportunities have similar characteristics to innovations and that creativity is necessary to identify and exploit opportunities. Two compilations of factors influencing creative and innovative activities were used as a basis

for the presented research: Maier et al. (2007) and Anderson et al. (2018). Since project management factors have an influence on the identification and handling of opportunities, project management literature was also approached. In his research, Feustel (2016) conducted a meta analysis on success factors, which was also included in this presented research.

4.2 Expert Group

Based on literature cited above and the results of our conference (Spang and Singer, 2017), which are not described explicitly in this paper, possible preconditions and success factors for the identification and treatment of opportunities were identified. We classified these factors into eight meaningful clusters. Starting point for the development of these clusters were two sources: On the one hand the classification of success and failure factors according to Belassi and Tukel (1996): "Factors related to the Project Manager and Project Team Members", "Factors related to the Project", "Factors related to the Organisation" and "Factors related to the external environment". On the other hand the classification of beneficial and hindering factors of innovations according to Maier et al. (2007): attributes of tasks, attributes of the person, factors of influence at the level of teams and factors of influence at the level of the organisation. Since Maier et al. (2007) make the distinction between attributes of the person and factors at the level of the group, we also have presented separately the two clusters "Attributes of the team members" (Cluster 1) and "Collaboration in teams" (Cluster 2) in a first step. In a second step, we regarded the behaviour of the management as a central element related to the project management: on the one hand the leadership of the team by the project manager (Cluster 3) and on the other hand the leadership of the entire organisation, expressed by the top management support (Cluster 6). The next step was to form clusters based on pro-

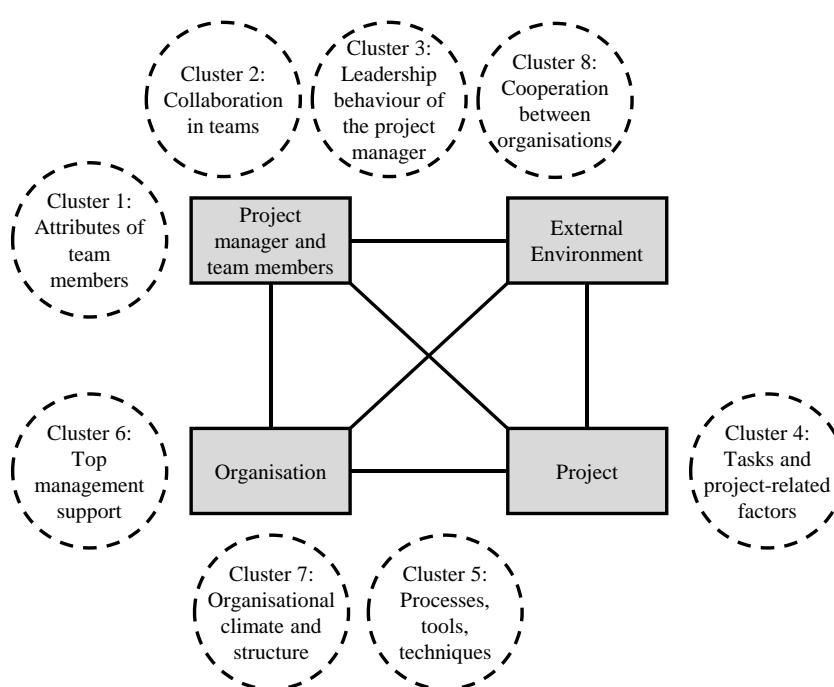


Figure 2. Eight developed clusters for classifying the success factors and preconditions to identify and manage opportunities in projects, related to the group of factors for projects in general, developed by Belassi and Tukel (1996)

ject management literature, which we regard as relevant for opportunity management in projects and which are not yet been covered by the existing clusters (Cluster 4, 5, 7, 8). As a final step, the factors found in literature were assigned to the clusters. Subsequently to the development, the clusters and the preconditions were discussed by the expert group and measures were derived to fulfil these preconditions.

The outcomes for each cluster resulting from the expert group are as follows:

Cluster 1: Attributes of team members

Cluster 1 summarises factors concerning attributes of individual humans and team members, such as personality or cognitive skills, which are seen to be important for identifying and exploiting opportunities. As the results of the expert group, team members should have a personality that is open to new experiences and have creative potential. In addition, they should have a sense of responsibility for tasks and face problems with a systematic approach for finding solutions. They have also the objective of continuous improvement and learning. Team members should have knowledge as well as intelligence. They are motivated by intrinsic or extrinsic incentives as well as high self-efficacy expectations and creativity goals. People with different experiences and perspectives work together in teams and the members feel bound to the group. In order to meet these preconditions, the expert group suggest the measures listed in Table 2.

Table 2. Measures, suggest by the expert group, to meet the preconditions in Cluster 1

# ...	Measures
1.1	Team members should be selected according to the appropriate project role
1.2	Creativity techniques supported by moderators and mentors should be used
1.3	The importance of the project and the innovation for the company as well as the associated development possibilities of the team members should be outlined
1.4	The choice of team composition (diversity, size, duration, degree of specialisation) should be suitable
1.5	The team of technical skills should be supplemented (temporarily) by creative heads

-
- 1.6 If necessary, individual team members should be changed during the project in order to meet the challenges of the project phases (creative minds at the beginning, handlers in later phases)
-

Cluster 2: Collaboration in teams

Cluster 2 summarises factors concerning the collaboration between humans and team members, such as team climate, communication and team size. As the results of the expert group, in order to identify and exploit opportunities, the team members should appreciate and support each other and there is no coalition building and power struggles. In team, there is an open and honest exchange as well as mutual, constructive feedback and problem-oriented discussions. The team size should not be too small or too large and the team composition is more constant than fluctuating to build trust between each other. In order to meet these preconditions, the expert group suggest the measures listed in Table 3.

Table 3. Measures, suggest by the expert group, to meet the preconditions in Cluster 2

# ...	Measures
2.1	An initial discussion or information regarding opportunity management should take place
2.2	Forums, exchange platforms, informal discussion groups, seminars or workshops should be set up, and team-building activities should be carried out
2.3	Project teams should be physically brought together or at least meet regularly
2.4	Company-wide rules for a common, mutually respectful style of communication should be established
2.5	Successes should be celebrated, and failures should be dealt with constructively, even during the ongoing project

Cluster 3: Leadership behaviour of the project manager

Cluster 3 summarises factors concerning the project manager and his leadership behaviour, such as decision-making or the communication to the team. As the results of the ex-

pert group, the project manager should adjust his leadership behaviour to the project phase: In early phases, he should support open-mindedness for new ideas, in late phases he should focus more on monitoring the implementation. In addition, the role of leadership should be clear, but not limit creativity in the team. The project manager should be willing to make courageous decisions and the team members should participate in the common decision-making process. The project manager should also encourage a culture of error, which does not mean that mistakes are welcome, but instead should be dealt with constructively if they occur. Furthermore, the project manager should appreciate the team's initiatives and have a supportive effect. Overall, there should be a good quality in the (exchange) relationship between manager and team members and the project manager should promote an open communication within the team. In order to meet these preconditions for identifying and exploiting opportunities in projects, the expert group suggest the measures listed in Table 4.

Table 4. Measures, suggest by the expert group, to meet the preconditions in Cluster 3

# ...	Measures
3.1	Suitable project leaders should be selected
3.2	Leadership behaviour should be adjusted to the project phase. If necessary, a change of the project manager should take place according to the requirements of the project phase
3.3	Employees should be appreciated, i.e. give regular feedback to and demand feedback from employees
3.4	Decisions should be made as far as possible within the team, and should be presented transparently (communicated to employees)
3.5	An open culture of error should be encouraged

Cluster 4: Tasks and project-related factors

Cluster 4 summarises tasks and project-related factors that affect the identification and exploitation of project opportunities (e.g. workload or task requirements). As the re-

sults of the expert group, an excessive workload of the team members should be avoided (time pressure, unrealistic expectations, etc.), and sufficient resources should be made available. Tasks and activities should be challenging and stimulating, requiring creativity and willingness to innovate. When carrying out tasks, there should be enough space for action and creativity. In addition, goals and visions should be motivating, clear, understandable and achievable or realistic. Information about the project should be up-to-date, transparent and available. In order to meet these preconditions, the expert group suggest the measures listed in Table 5.

Table 5. Measures, suggest by the expert group, to meet the preconditions in Cluster 4

# ...	Measures
4.1	The topic of opportunities should be embedded in the ongoing project organisation and processes
4.2	Project goals or visions should be formulated clearly, comprehensibly and realistically
4.3	Space for action should be given as far as possible. This requires trust towards the project team and the team members
4.4	A realistic space in the (early) project phases should be agreed, which takes into account the discussion of opportunity evaluation or alternative scenarios

Cluster 5: Processes, tools, techniques

Cluster 5 summarises factors concerning processes, tools and techniques that affect the identification and exploitation of project opportunities. As the results of the expert group, an organisation- or project-specific opportunity management process as well as instruments to encourage opportunities in projects should be used (e.g. creativity techniques) in order to identify and exploit opportunities. In projects, the environment should be analysed, stakeholder requirements identified and orientation towards the customer should take place. In addition, there should be documentation to track decisions. In order to meet these preconditions, the expert group suggest the measures listed in Table 6.

Table 6. Measures, suggest by the expert group, to meet the preconditions in Cluster 5

# ...	Measures
5.1	An opportunity management process should be integrated into the company's project management process
5.2	Techniques to identify opportunities should be used
5.3	Techniques for assessing and evaluating opportunities should be used
5.4	A company-wide standardized documentation of typical decisions should exist in order to make decision paths comprehensible in terms of content

Cluster 6: Top management support

Cluster 6 summarises factors concerning the behaviour and the support of the top management in an organisation that affect the opportunity management in projects. As the results of the expert group, the top management should have a positive attitude towards opportunities, set an example for employees and the project team, and act as a promoter of opportunity management in projects. In order to meet these preconditions, the expert group suggest the measures listed in Table 7.

Table 7. Measures, suggest by the expert group, to meet the preconditions in Cluster 6

# ...	Measures
6.1	A corporate culture that promotes innovation and opportunities should be established
6.2	Personnel development strategies that take opportunity management into account should be pursued and implemented
6.3	A regular exchange on opportunities at management level should take place
6.4	An open leadership culture should be exemplified and promoted. Examples of such a culture are: <ul style="list-style-type: none"> • Promoting motivation: Awakening fire and enthusiasm among employees • Fault tolerance and a culture of acceptance • Open-mindedness • Appreciation • Flexibility and reflexivity

Cluster 7: Organisational climate and structure

Cluster 7 summarises factors concerning the organisational climate and structure, such as organisational communication and transfer of knowledge. As the results of the expert group, in order to identify and exploit opportunities, centralisation and inflexible hierarchies should change towards agile corporate structures. Furthermore, an organisation-wide knowledge management system (e.g. lessons learned, best practice) and cooperation/communication across groups and departments should be encouraged. Harmful rivalries between organisational units or political problems should be avoided. In order to meet these preconditions, the expert group suggest the measures listed in Table 8.

Table 8. Measures, suggest by the expert group, to meet the preconditions in Cluster 7

# ...	Measures
7.1	Flat hierarchies should exist in the company and in project management
7.2	Key project team members from all hierarchical levels should be involved in presenting project decisions (alternative concepts) and opportunities to decision-makers
7.3	A project database should be used to enable research on opportunities (e.g. experience, technical information, justification for not implementing)
7.4	Forums, exchange platforms, informal discussion groups or open seminars for employees should be established

Cluster 8: Cooperation between organisations

Cluster 8 summarises factors concerning cooperation between organisations, e.g., when there is a contract between two parties in a project. As the results of the expert group, partnerships should be based on a sustainable relationship or partnership characterised by mutual trust, respect, openness and fairness, in order to identify and exploit opportunities in projects. In addition, cooperation should be based on clear key competencies and clear benefits for the partner and there should be a fair distribution of risks. In order to meet these preconditions, the expert group suggest the measures listed in Table 9.

Table 9. Measures, suggest by the expert group, to meet the preconditions in Cluster 8

# ...	Measures
8.1	There should be active efforts to understand each other's goals and motivations
8.2	There should be a fundamental willingness to share burdens fairly (development of an opportunity) and benefits if an opportunity can be exploited
8.3	Clear limits to transparency should be established
8.4	There should be a common understanding of opportunities and opportunity management in the project

5. CONCLUSION

Although there are several approaches to opportunity management in projects, the identification and exploitation of opportunities is still not fully understood. In particular, a comprehensive study of preconditions and success factors and their operationalisation in projects and organisations has not yet been carried out. Nevertheless, there are some authors, who pointed out the important role of the project manager, e.g. Lechler et al. (2012). In the presented research, we tried to examine the success factors for identifying and exploiting opportunities in project in a broad way. For this purpose, we set up an expert group with participants from various industries. Success factors in literature of project management and innovation and creativity were discussed and classified into eight clusters. Subsequent-

ly, we suggested concrete measures to meet the identified success factors for each cluster. The classifying in clusters helps to understand the relationship between success and options for measures. The results suggest that the identification and dealing with opportunities in projects depends on different factors and that there are interfaces to different fields such as stakeholder management, knowledge management or cognitive science, to name a few. The results also indicate that trust is an element for opportunity management in projects in different ways, considering cluster 2, 3, 4 and 8. Our proposition is, that trust is essential in three types of context in order to identify and exploit opportunities in projects and finally to create added value beyond the set project goals:

- Trust between team members and between team members and the project manager in order to communicate opportunities in projects
- Trust towards team members in order to give them space for creativity and creation
- Trust between organisations in external projects in order to deal with opportunities and realise them in a partnership

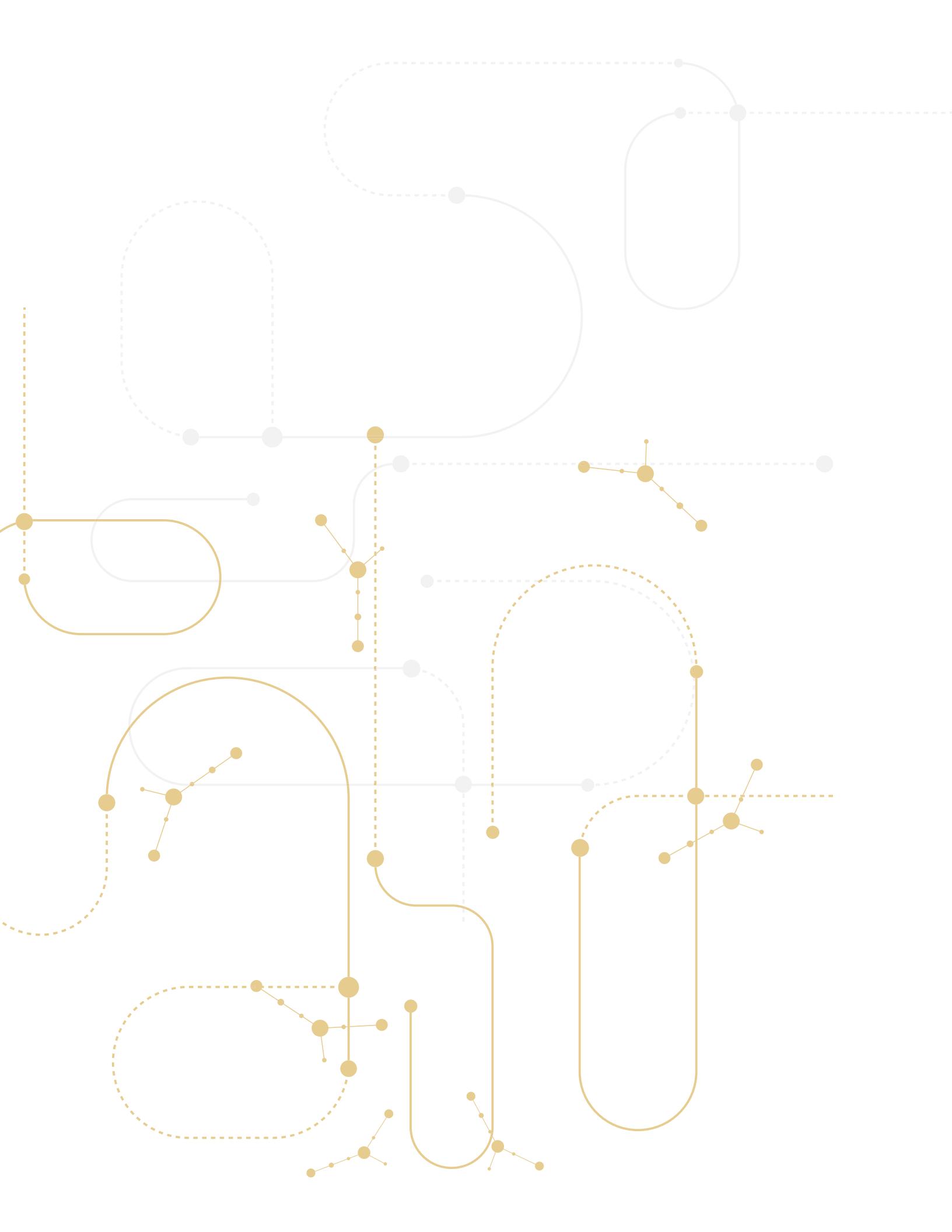
Although the study is broadly based, we consider that the results and measures presented in this article – of course in an adapted way – can be fully applied to mega projects. However, it can be assumed that not all factors have the same importance. Further research is needed to examine which of these identified clusters, preconditions and measures are most critical for success and which relationships exist between the clusters.

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IV.

Drivers and Barriers in Building Trust in Projects



Rediscovering Trust in Green Building Projects

ABSTRACT

In recent years, environmental consequences that caused by the construction sector have become apparent and various solutions have been offered by the professionals. Green buildings are recognized as an important step towards these issues. However, this newly emerging organizational structure for green buildings creates new challenges in terms of trust. This paper generates a framework to measure the importance of the features related to trust among professionals for green buildings. For this purpose, firstly the concept of trust has been identified with a literature review for inter-organizational boundaries. A brief literature review of different green building certification systems is summarized. Affect, cognition and system-based trust with certification system's governance and cooperation measures are evaluated with the green building characteristics. Secondly, a qualitative study methodology has been employed to gain a better understanding of the critical trust factors for various green building certification categories and partnerships. In this respect, professionals that are participated in a major conference of green buildings are interviewed and an online questionnaire is distributed to the volunteers. The results of the study indicated the relationships that system-based trust is the most important type and establishing an effective communication platform is crucial for green certification and partnering. Lastly, the study offered strategies to overcome problems related to trust between the project participants of green buildings. The outcomes of this study are expected to guide each green building participant to better fulfill the expectations regarding the trust concept from the opponent's point of view.

Keywords: Trust; Green Buildings; Certification; Framework; System-based; SPSS

1. INTRODUCTION

Traditional design and construction practice have been changed drastically through sustainability efforts in the last thirty years (Ding *et al.*, 2018). Sustainability paradigm to the built environment was coined because the way we used to design and build was no longer satisfying the demands of the future (Kibert, 2016). Therefore, green buildings promoted that the buildings could create more comfortable, healthy, environmentally friendly and safe environments while reducing waste and pollution.

The change of a fundamental industry such as construction created a huge movement in sustainable thinking. Even in the U.S. alone, the size of the green building market raised up to 81 billion dollars from 48 billion dollars between 2010 and 2014 (Statista, 2019). Even more optimistic numbers were enounced by Hamilton (2015) that green building in the US is expected to support 3.9 million jobs and add 303 billion dollars to the GDP from 2015 to 2018 (Guardian, 2015). It is expected that global green building materials market size is to reach 377,029 million dollars by 2022 from 171,475 million dollars in 2015 with a compound annual growth rate of 11.9% from 2016 to 2022 (Allied Analytics LLP, 2016). These numbers put forward the tremendous increase of interest in global green building practices and certification systems. Also, the world-wide green building industry is growing much faster with the increase in the number of green building professionals specialized in different systems. So, it is crucial

to understand their comprehensive perceptions of green buildings in trust-related issues to understand the problems and enhance upcoming opportunities.

This study aims to give information about the green building certification systems and measure the trust-related relationships with measuring affect, cognition and system-based trust with certification system's governance and cooperation, and the importance level of the green certification system categories.

2. LITERATURE REVIEW

In the literature review, green building certification systems are summarized. Also, trust-related studies in the literature are identified.

2.1 Green Building Certification Systems

Green building certification is a confirmation that a building meets the defined criteria of a green building standard. Green building certification systems are being frequently used today as a measure to enhance the level of sustainability for the built environment. Many certification systems are constituted in order to meet the varying needs of the local customers (Gurgun *et al.*, 2016) where only several systems could influence the industry internationally. Systems that can alter and accord with different climate, topography, timing, credit synergies, and local building standards remain universally successful. It is estimated that there are nearly 600 green product certifications in the world with nearly 100 in use in the U.S., and the numbers continue to grow (Viera, 2016). Green Building certification systems concerned about common environmental measures and suggest similar precautions even though the assessment systems are completely different. Assessments vary in their approach from outlining prerequisites and optional credits to normative rules or performance-based requirements. Brief explanations about the green building systems involved in the survey are explained below.

LEED; or Leadership in Energy & Environmental Design certification system was first pilot tested in 1998 by United States Green Building Council (USGBC) in the U.S. which could be referred as the most influential and comprehensive green building certification system community today (in 165 countries). The system has continuous version improve-

ments. The last version of LEED, v4.1 is available -where rumors tell version 4.2 is soon to be released-, yet over 80% of the certification is still taken by v3-2009 according to the first quarter of 2019 in commercial projects (Tufts, 2019). All in all, experts were asked to evaluate all systems according to the categories of this certification system.

BREEAM; or Building Research Establishment's Environmental Assessment Method that launched and operated by the Building Research Establishment (BRE) in 1990 (Lee and Burnett, 2008). BREEAM is the longest established framework for assessing, rating and certifying the sustainability of buildings firstly designed to assess new office buildings.

DGNB; or Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB e.V.) established by German Sustainable Building Council in 2008, focuses on the entire lifecycle of environmentally friendly and energy efficient buildings to help preserve natural resources and ensure a high level of wellbeing for its users. The system was developed for the German building sector so it is based primarily on German standards and technical directives. In 2010, the DGNB International scheme was prepared with the intention of making the trademark present internationally. This scheme complies with EU regulations and standards (Wallbaum and Hardziewski, 2011). It has been argued that this system is superior to other well-known systems in terms of sustainability for neighborhood development projects (Reith and Orova, 2015).

WELL Building Standard; launched in October 2014 seeking to focus on enhancing people's health and wellbeing through the built environment. The standard has a performance-based system for measuring, certifying, and monitoring features of the built environment and have strong integration in between scientific and medical research and literature on environmental health, behavioral factors, health outcomes, and demographic risk factors. The International Well Building Institute is featured on Fast Company's World's Most Innovative Companies list – 2019 (IWBI, 2019). The aggressive growth of the WELL standard in the field of green building certification represents its importance of a candidate that can guide the sector in the near future.

Green Star; established by the Green Building Council of Australia in 2002 which is the nation's authority on sus-

tainable buildings, communities, and cities. In this system, the number of stars shows the degree of excellence, not like other systems using silver and gold certification levels. Green Star rating scheme has been actively supported by the property industry in Australia and has influenced Australia's property and construction markets (Newell *et al.*, 2014). There are over 2,000 Green Star-rated projects (GBCA, 2019).

CASBEE; or Comprehensive Assessment System for Building Environmental Efficiency was introduced as a collaboration and development project of the Japanese government, industry, and academia in 2001 (Haapio, 2012). Even though the system is being evaluated with a broad extent, limitations with the Japanese context resulted in a relatively modest number of buildings (Doan *et al.*, 2017). As of April 2015, the total number of CASBEE certified buildings is over 450 (IBEC, 2015).

CEDBIK; or B.E.S.T green building certification system introduced by "Cevre Dostu Yesil Binalar Dernegi" and launched its first comprehensive version in 2018 where its first draft already came onto the market in 2012. This system aims to prevent the transfer of financial resources outside of the country (Bayhan, 2017). The certification system guide possesses similarities with LEED but also complied with Turkish regulations. Still, the extent is limited and the governmental incentive seems necessary for its rapid development.

Ecostandard; is introduced by a local Muscovite firm, called Ecostandard Group of Companies which was established in 1997 on the basis of a number of leading scientific centers in Moscow, including the natural faculties of the Moscow State University (Ecostandard, 2019). The institution is a member of United States Green Building Council (USGBC). The Russian Green Building Certificate become legalized in April 2013. The overall grade in the Ecostandard assessment is determined by the percentage of the credits gained under each category and their weighting factors.

BEAM Plus; or Building Environmental Assessment Method Plus scheme was established in 1996 in Hong Kong (Wong and Kuan, 2014). The assessment methodology is similar to the Ecostandard certification system with its scoring system

is maintained by the percentage of credits under categories (Chen and Lee, 2013).

2.2 Trust in Construction

Trust is a concept which is mainly related to our social belonging needs according to Maslow's five-step hierarchy of needs. The way to achieve safety, esteem and self-actualization steps could also be associated with trust-related situations or actions (Cook and Wall, 1980). Trust is an indispensable key component in construction projects as well as in our social lives. This interactive, dynamic and inherently ongoing process affects the success of the construction projects in partnering (Pinto *et al.*, 2009, Cheung *et al.*, 2011) or following recently generated concepts like green buildings. The eagerness to invest in newly emerging concepts are most of the time related to their capacity of profitability (Mantara *et al.*, 1992). However, the superficial analysis combined with misleading profiles could devastate the intentions. An example from the psychology - Milgram tests represent the terrifying consequences of misevaluating the authority figure (Blass, 1999). Therefore, studies conducted in the fields of both psychology (Spector and Jones, 2004, Zaugg and Davies, 2013, Greenwood, 2019) and management (Cheung *et al.*, 2013, Ko, 2014, Buvik and Tvedt, 2016, Ning, 2017, Javed *et al.*, 2018, Rezvani *et al.* 2018) to understand the trust concept in detail with several dimensions in project teams and performance.

Each person is born with a propensity to take risk which is driven by geography, family, upbringing, and society (Davis, 2014). In construction, these drivers could be translated as the area of job freedom, organization, culture, and environmental measures. In order to mitigate those risks, a trust-based environment is necessary. Fulmer and Gelfand (2010) argued that trust included a minimum of three stages: formation, dissolution, and restoration. As a traditional procedure, mutual trust could be built upon a contract to avoid risks (Rousseau *et al.*, 1998) in construction. Moreover, Lui and Ngo (2004) argued that contracts can curb opportunism. But a successful construction partnering could not only be achieved by the legal documentary. Collaborative relationships, effective communication among project partners (Barczak *et al.*, 2010), sophisticated emotional trust (Lau

and Rowlinson, 2010), flexibility and sincere helping environment (Wang *et al.*, 2015) are some of the key measures to implement a successful project.

In the construction industry, incorrect planning or unforeseen breakdowns often arise resulting in the breach of trust. Khalfan *et al.* (2007) emphasized the necessity of a cultural change on building trust and avoid breaching; a move from a blame culture to a problem-solving culture in the construction industry. Reflecting dedication and benevolence not driven by ego are preventive acts to discrepancy (Laan *et al.*, 2011). Also, perspective thinking, coaxing, and forgiving atmosphere enhances the trust between partners (Langer *et al.*, 2010). Integrity should be the key measure while judging the failure of a company (Chance *et al.*, 2015).

2.3 Role of Trust in Green Buildings

Environmental measures boosted green building movement which grasps a better way to respond to the society's requirements. With its innovative ideas, green building movement tends to reshape the rules of the construction. Also, green buildings have been a major research concern in the last decade. Various approaches are recently conducted in order to identify the certification procedures (Lu *et al.*, 2019, Wu *et al.*, 2019), sustainability assessments (Ferwati *et al.*, 2019, Shaikh *et al.*, 2019) or the cost-benefit analysis (Ade and Rehm, 2019, Huang *et al.*, 2019). However, the trust term in between the construction professionals has not been examined previously.

Major advantages of that kind of buildings could be summarized as; (1) complying with environmental trends, (2) enhancing competitive advantages, (3) increasing corporate images, (4) raising product value and (5) utilizing green opportunities (Chen, 2008). Chen and Chang (2012) argued that green perceived value positively relates to both green trust and green purchase intentions. Liu *et al.* (2018) found that lacking social trust and subjective knowledge could be the psychological barriers to their acceptance of Green Labeled Residential Buildings. Also, the response of the consumer market to green buildings has been limited to government interventions (Liu and Hu, 2019). Moreover, Durdyev *et al.* (2018) conducted a questionnaire survey among Cambodian building professionals to evaluate their perceptions of sustainable construction. The study concluded that the building industry seldom conducted sus-

tainable construction due to a lack of awareness and related knowledge, and they were unwilling to adopt new sustainable materials. Besides cost, time and quality constraints adding a new measure like sustainability is prone to possess more risks. Therefore, with more risks, more trust is needed (Jing and Ling, 2005). Previous studies considered green certification systems as the main trust indicator (Eberl, 2010, Hamedani and Huber, 2012). It is crucial to evaluate green building professionals' perspectives on trusting the green building concept, certification systems and partnerships.

- **Affect-Based Trust:** Emotional bonds in between the project partners constitute an affect-based trust. Personal feelings such as willingness to consider and care others instead of exploiting vulnerabilities and perspective thinking are some of the examples. It is crucial to minimize claims and conflicts and bring flexibility (Hempel *et al.*, 2009). The skills to exchange and evaluate the information are being improved by the level of this type of trust (Wong *et al.*, 2008, Ke *et al.*, 2015).
- **Cognition-Based Trust:** Objective information, track records, communication between partners and confidence in partners' competence constitute cognition-based trust (Wong *et al.*, 2008, Ke *et al.*, 2015). Leung *et al.* (2004) put forward the importance of commitment to the success of construction projects.
- **System-Based Trust:** Clear definition of job tasks, measures of contract, and platforms to mitigate the risks and find the solutions are the components of system-based trust. Emotional or personal remarks are not considered in this category (Meng, 2010, Ke *et al.*, 2015).
- **Certification Systems Governance:** Certification systems is the backbone of trust in green buildings. The detail governance of these systems needs to be evaluated in various subjects from the sufficiency of the guidelines to match the evolving client requirements. This way the validity of these systems is measured.
- **Cooperation:** Cooperation is an important measure to build trust between partners (das and Teng, 1998, Jones and George, 1998). This category considers constituting conflict solution policies, cross trainings, joint objectives, information share, and organizational systems.

3. METHODOLOGY

A literature review is conducted to find a common characteristic framework for green building certification systems. Therefore, respondents' familiarity on nine green building certification is measured and the common certification system categories to measure their importance are taken from the LEED certification system because of its prominent role in the industry and the results of the study revealed that the percentage of respondents specialized to this system is over 87%. Also, while distributing the questions, respondents' comments gathered and a common framework is created. After this, trust-based literature is examined to fully understand the trust concept in green buildings. Therefore, trust is identified under five categories namely; affect, cognition, system-based, certification systems governance, and cooperation. Participants are asked to measure nineteen questions under these categories. An online questionnaire was sent out to construction professionals to understand how extensively the trust related factors are identified and applied in practice. The Likert scale (from 1 to 5) is adopted to measure the impacts of questions related to both certification systems and trust. Pilot interviews with the two industry-professionals showed that respondents were clear with the statements in the questionnaire and could relate green building concepts with trust.

A total of 100 online questionnaires were sent out between March and April 2019 to green building professionals with different backgrounds, where mostly engineers (41,2%) are involved. The profile of the respondents could be followed

in Table 1. At the end of the survey closure, 34 responses were received which represents a response rate of 34%. The number of responses is sufficient for parametric tests (Yilmaz and Yilmaz, 2005). SPSS version 25.0 is used to generate statistical information. One of the most important strengths of this study is its experienced international green building respondent profile; there are respondents from 17 different countries and 26 different cities (from Copenhagen to Brisbane). The questionnaire is answered substantially by the respondents planned or implemented one or more green building projects (73,5%) where all respondents are confirmed about the actual meaning of green buildings.

The measurement instrument is regarded satisfactory for all five categories because of the Cronbach's alpha values of these categories are found ($\alpha= 0.774$) where 0.7 or higher indicate acceptable consistency (Taber, 2018). Also, the common categories received from the LEED system has very satisfactory reliability ($\alpha= 0.856$) for internal consistency. Razali and Wah (2011) argued that if the number of respondents is below 50, Shapiro-Wilkinson tests used to determine the normality of data distribution. Our data remained in the limits between +1,5 and -1,5 (Tabachnik *et al.*, 2007) for both green building categories importance and the trust related categories. There are some categories need to be carefully examined in terms of statistical data regarding green building certification systems. These questions were asked in order to find the familiarity level for the system, so the minor differences in skewness and kurtosis test results and differences would be acceptable as there is knowledge difference for country-specific certification systems.

Table 1. Summary statistics for respondents

Respondents	Sub-Group	n	%	Mean	Median	St. Dev.
Sex	Female	16	47,1			
	Male	18	52,9			
Occupation	Architect	10	29,4			
	Engineer	14	41,2			
	Other	10	29,4			
Educational Status (Degree)	Associate or High-School (1)	2	5,9	2,4706	3	0,61473
	Bachelor (2)	14	41,2			
	Master (3)	18	52,9			
	Ph.D. (4)	0	0			
Green Building Industry Experience (Years)	0-5 (1)	18	52,9	1,8529	1	1,01898
	5-10 (2)	5	14,7			
	10-20 (3)	9	26,5			
	20+ (4)	2	5,9			
Familiarity Level to Green Building	Generally aware of the concept, its meaning, and how some buildings are using it (3)	5	14,7	4,5882	5	0,74336
	Actively investigating green building ideas (4)	4	11,8			
	Planned or implemented one or more green building projects (5)	25	73,5			
Institution	Owner	4	11,8			
	Design Professional	3	8,8			
	General Contractor	3	8,8			
	Consultancy Firm	17	50			
	Governmental Agency	1	2,9			
	Certification Agency	2	5,9			
Title	Other	4	11,8			
	CEO	3	8,8			
	Manager	12	35,3			
	Consultant	11	32,4			

Title	Student	5	14,7			
	Researcher / Academician	2	5,9			
	Other	1	2,9			
City	Istanbul	6	17,6			
	Amsterdam	2	5,9			
	Holzminden	2	5,9			
	Warsaw	2	5,9			
	Other	22	61,8			
City Incentive for Green Buildings	Don't Know (0)	5	14,7	1,3824	2	0,73915
	Yes (1)	11	32,4			
	No (2)	18	52,9			

4. RESULTS

The analyses of the survey data reveal that the Energy and Atmosphere category is ranked as the most important green building certification category followed by Indoor Environmental Quality, Water Efficiency, and Material and Resources categories. Regional Priority, Innovation, and Inte-

grative Process are ranked as the least important categories in green building certification. As an average, the familiarity level of the certification systems ranked as; LEED, BREEAM, WELL, DGNB, Green Star, CEDBIK, CASBEE, Ecostandard and BEAM Plus. The reason a new certification system from Turkey is more familiar than Japanese CASBEE is the relatively higher number of respondents from Istanbul city.

Table 2. Descriptive statistics for green building systems, the importance of the categories and green building systems trust

	Mean	Std. Deviation		Mean	Std. Deviation
Familiarity	4,588	0,743	Level of Imp. (Trust)		
LEED	4,382	0,985	Affect Based Trust 1 (A1)	3,471	0,706
BREEAM	3,235	1,156	Affect Based Trust 2 (A2)	3,588	0,701
DGNB	2,235	1,478	Affect Based Trust 3 (A3)	3,912	0,379
WELL	3,088	1,464	Cognition Based Trust 1 (COG1)	4,059	0,694
Green Star	1,500	1,052	Cognition Based Trust 2 (COG2)	3,941	0,547
CASBEE	0,853	0,892	Cognition Based Trust 3 (COG3)	3,912	0,793
CEDBIK	0,912	1,583	Coordination Trust 1 (COO1)	4,382	0,604
Ecostandard	0,500	1,108	Coordination Trust 2 (COO2)	3,677	0,912
BEAM Plus	0,382	0,817	Coordination Trust 3 (COO3)	4,088	1,083
Level of Imp. (Categories)			Coordination Trust 4 (COO4)	3,559	1,078
Location & Transportation	4,000	1,044	Coordination Trust 5 (COO5)	3,559	1,160
Sustainable Sites	4,000	0,778	Governance Trust 1 (G1)	3,824	0,869
Water Efficiency	4,412	0,892	Governance Trust 2 (G2)	4,000	0,603
Energy & Atmosphere	4,853	0,359	Governance Trust 3 (G3)	3,912	0,668
Material & Resources	4,265	0,963	Governance Trust 4 (G4)	3,677	0,843
Indoor Environmental Q.	4,471	0,615	Governance Trust 5 (G5)	3,471	0,748
Innovation	3,294	1,142	System Based Trust 1 (S1)	4,324	0,638
Regional Priority	3,088	1,190	System Based Trust 2 (S2)	4,588	0,557
Integrative Process	3,529	1,502	System Based Trust 3 (S3)	4,147	0,821

The analyses regarding to trust revealed that system-based trust ($mean=4,35$) is the most important trust type followed by cognition-based trust ($mean=3,97$), coordination trust ($mean=3,85$), governance trust ($mean=3,77$) and affect-based trust ($mean=3,66$). S2 (establishing an effective communication platform) is found as the most crucial trust factor for green certification of buildings, where COO1 (explicit joint objectives between partners) is the second crucial factor. A1 (your long-term partners will show care and concern to their workmates at the appropriate time) and G5

(respond quickly to match evolving client requirements) are found as the weakest terms in trust measurement of the certification systems. Therefore, green building professionals put emphasize on the communication related factors on the trust mechanisms. It could be concluded with the mean scores that an effective communication system with the joint objectives especially on energy and atmosphere and water efficiency related categories is the key of building trust in green buildings systems.

Table 3. Questions asked related to green building system trust (translated from Ke et al., 2015)

Code	Explanation
A1	You believe that your long-term partners will show care and concern to their workmates at the appropriate time for green building projects.
A2	You believe that the long-term partners will consider from your perspective in green building projects.
A3	You believe that there is good personal relationship within the project team, which guaranteeing a good working relationship.
COG1	In green building projects, you believe that there are good interaction and communication within the project participants so as to facilitate better understanding among individuals.
COG2	According to the track record of partners, you believe your cooperation partners are capable of the upcoming green building projects.
COG3	You believe that all the long-term partners recognize integrity is the foundation of cooperation.
COO1	There is a need to explicit joint objectives between you and your long-term partners in green building projects.
COO2	There is a need to establish a policy for conflict solution within green building project participants.
COO3	There is a need to establish an IT-database for shared information within the green building project participants.
COO4	There is a need to establish a coordination office (or similar institution) within the green building project participants.
COO5	In green building projects, your long-term partners need to commit to team building activities.
G1	The certification system has detailed the obligations and rights of every party.
G2	We have a clear expression of the default definitions and formula in the certification system.
G3	The certification system has specified the procedures and methods for disputes.
G4	The certification system has specified major principles or guidelines for handling unanticipated contingencies as they arise.
G5	The certification system has allowed us to respond quickly to match evolving client requirements.
S1	In green building projects, you believe that the long-term partners need to clearly define the job tasks required of each parity, in order to reinforce goal.
S2	In green building projects, you believe that there is a need to establish an effective communication platform with the project participants to avoid ambiguous situations and discrepancies.
S3	In green building projects, you believe that there is a need to clearly define the contract document within the project participants so as to minimize future arguments.

According to independent sample t-tests (Table 4), in water efficiency, material and resources and innovation categories, female respondents gave statistically significantly higher points than their male counterparts. Respondents

from other institutions (subcontractors, suppliers etc.) gave statistically significantly higher points to A1 than respondents working in an owner company. The marked groups (*) in table 4 gave statistically significant points than the other

group. Significances are given at the right end column which represents the statistical significance, if smaller than 0,05 (Ketteler *et al.*, 2003).

Also, ANOVA tests are implemented in between the categories, could be followed from Table 5. According to the educational status, master degree holders have a greater familiarity with green building standards and gave statistically higher scores for location and transportation category than associate or high-school degree holders. Respondents

from Istanbul found more familiar to both CEDBIK and Eco-standard certification systems than all other respondents. Respondents answering the question for city incentives either positively or negatively gave higher points for both location and transportation and sustainable sites than the respondents could not answer the question. The importance of G5 (responding quickly to the match client requirements) ranked higher in bachelor or master holders than associate or high-school degree holders.

Table 4. Significance in the Independent Sample t-tests

Dependent	Group 1	Group 2		Levene's F	Test Sig	Sig. (2-tailed)
Water Efficiency	Female*	Male	Eq. var. as.	10,752	0,003	0,011
			Eq. var. not as.			0,010*
Material and Resources	Female*	Male	Eq. var. as.	8,034	0,008	0,013
			Eq. var. not as.			0,012*
Innovation	Female*	Male	Eq. var. as.	0,184	0,671	0,026*
			Eq. var. not as.			0,025
A1	Consultancy Firm	Other*	Eq. var. as.	0,004	0,948	0,039*
			Eq. var. not as.			0,134
COG2	CEO*	Student	Eq. var. as.	0,117	0,744	0,040*
			Eq. var. not as.			0,059
COG3	Consultancy Firm	Other*	Eq. var. as.	2,042	0,169	0,012*
			Eq. var. not as.			0,008
C001	Consultant	Researcher / Academician*	Eq. var. as.	7,211	0,021	0,224
			Eq. var. not as.			0,011*
C001	Manager*	Student	Eq. var. as.	.	.	0,053
			Eq. var. not as.			0,007*
C001	Manager	Researcher / Academician*	Eq. var. as.	.	.	0,215
			Eq. var. not as.			0,007*
C003	Consultancy Firm	Other*	Eq. var. as.	5,245	0,034	0,209
			Eq. var. not as.			0,043*
C003	Owner	Other*	Eq. var. as.	0,000	1,000	0,030*
			Eq. var. not as.			0,030

C004	Design Professional*	Consultancy Firm	Eq. var. as.	1,776	0,199	0,04*
			Eq. var. not as.	0,014		
C004	General Contractor*	Consultancy Firm	Eq. var. as.	6,364	0,021	0,216
			Eq. var. not as.	0,007*		
G2	CEO*	Manager	Eq. var. as.	3,735	0,075	0,022*
			Eq. var. not as.	0,217		
G2	CEO*	Student	Eq. var. as.	0,117	0,744	0,040*
			Eq. var. not as.	0,059		
G2	Female	Male*	Eq. var. as.	1,848	0,184	0,020*
			Eq. var. not as.	0,018		
G4	Consultant*	Student	Eq. var. as.	1,482	0,244	0,024*
			Eq. var. not as.	0,071		
G4	Manager	Consultant*	Eq. var. as.	0,304	0,587	0,028*
			Eq. var. not as.	0,028		
G5	CEO	Consultant*	Eq. var. as.	5,443	0,038	0,201
			Eq. var. not as.	0,024*		
G5	Consultancy Firm	Certification Agency*	Eq. var. as.	5,556	0,031	0,45
			Eq. var. not as.	0,034*		
G5	Manager	Consultant*	Eq. var. as.	0,304	0,587	0,028*
			Eq. var. not as.	0,028		
S1	Consultant*	Student	Eq. var. as.	54,444	0	0,015
			Eq. var. not as.	0,002*		
S2	Consultancy Firm	Certification Agency*	Eq. var. as.	9,1	0,008	0,313
			Eq. var. not as.	0,007*		
S2	General Contractor*	Consultancy Firm	Eq. var. as.	13,731	0,002	0,218
			Eq. var. not as.	0,007*		

Table 5. Significance in the ANOVA tests

Group	Dependent Variable		Groups to Compare		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
	Code	Test	First Group	Second Group				Lower Bound	Upper Bound
Educational Status	Familiarity	T	Associate or High-school Degree	Master's Degree*	-1,333	0,509	0,035	-2,585	-0,082
	Location and Transportation	T	Associate or High-school Degree	Bachelor Degree*	-2,071	0,711	0,018	-3,822	-0,321
	Location and Transportation	T	Associate or High-school Degree	Master's Degree*	-2,167	0,701	0,011	-3,892	-0,441
Green Building Industry Experience	WELL	T	0-5	10-20*	-1,444	0,514	0,040	-2,841	-0,048
	WELL	T	5-10	10-20*	-2,422	0,702	0,009	-4,330	-0,515
	Location and Transportation	T	0-5	10-20*	-1,167	0,393	0,028	-2,236	-0,097
City	Familiarity	T	Istanbul*	Amsterdam	1,667	0,472	0,011	0,294	3,039
	Familiarity	T	Amsterdam	Warsaw*	-2,000	0,578	0,014	-3,681	-0,319
	Familiarity	T	Amsterdam	Other*	-1,773	0,427	0,002	-3,014	-0,531
	Familiarity	T	Holzminden	Other*	-1,273	0,427	0,042	-2,514	-0,031
	LEED	T	Istanbul*	Amsterdam	2,167	0,660	0,021	0,249	4,084
	LEED	T	Amsterdam	Other*	-2,136	0,597	0,010	-3,871	-0,402
	CEDBIK	T	Istanbul*	Amsterdam	4,000	0,474	0,000	2,622	5,378
	CEDBIK	T	Istanbul*	Holzminden	2,500	0,474	0,000	1,122	3,878
	CEDBIK	T	Istanbul*	Warsaw	4,000	0,474	0,000	2,622	5,378
	CEDBIK	T	Istanbul*	Other	3,818	0,267	0,000	3,041	4,595
	Ecostandard	T	Istanbul*	Amsterdam	2,167	0,677	0,025	0,199	4,134
	Ecostandard	T	Istanbul*	Warsaw	2,167	0,677	0,025	0,199	4,134
	Ecostandard	T	Istanbul*	Other	2,030	0,382	0,000	0,921	3,140
City Incentive	Location and Transportation	T	Holzminden	Other*	-2,227	0,704	0,028	-4,274	-0,180
	Location and Transportation	T	Don't Know	Yes*	-1,491	0,476	0,010	-2,662	-0,320
	Location and Transportation	T	Don't Know	No*	-1,733	0,446	0,001	-2,831	-0,636
	Sustainable Sites	T	Don't Know	No*	-1,022	0,362	0,022	-1,914	-0,131
Occupation	Sustainable Sites	T	Don't Know	No*	-2,200	0,677	0,008	-3,865	-0,535
	Architect	T	Architect*	Other	1,000	0,356	0,023	0,124	1,877

Education Status	G5	T	Associate or High-school Degree	Bachelor Degree*	-1,857	0,565	0,007	-3,248	-0,466
	G5	T	Associate or High-school Degree	Master's Degree*	-1,722	0,557	0,011	-3,094	-0,351
City	G4	T	Istanbul*	Holzminden	1,833	0,629	0,049	0,006	3,661
	G4	T	Holzminden	Other*	-1,727	0,569	0,037	-3,381	-0,074

T: Tukey

Moreover, according to the regression results, the following hypothesis could be put forward;

- Educational status is explaining the (unstandardized B) 0,528 or (standardized Beta) 0,437 of familiarity level to green building certifications (R-square of 0,191*, and adjusted R-square of 0,166). So, *educational status is in direct proportion to the familiarity level to green building certifications.*
- City incentive is explaining the (unstandardized B) 0,68 or (standardized Beta) 0,481 of location and transportation category (R-square of 0,499, and adjusted R-square of 0,339*). So, *city incentive has a direct proportion of the respondent perception on location and transportation category.*
- CO02 is explaining the 0,73 (unstandardized B) or (standardized Beta) 0,637 of Location and Transportation category (R-square of 0,395, and adjusted R-square of 0,287*). So, *establishing policy for conflict solution within green building project participants have a direct proportion on the respondent perception on location and transportation category.*
- CO05 is explaining the (unstandardized B) 0,566 or (standardized Beta) 0,736 of Water Efficiency category (R-square of 0,493, and adjusted R-square of 0,402*). So, *long-term partners need to commit to team building activities have a direct proportion of the respondent perception on water efficiency category.*
- G1 is explaining the (unstandardized B) 0,252 or (standardized Beta) 0,356 and G5 is explaining the (unstandardized B) 0,379 or (standardized Beta) 0,432 of indoor

environmental quality category (R-square of 0,397, and adjusted R-square of 0,289*). So, *the certification system has detailed the obligations and rights of every party have a direct proportion of the respondent perception on indoor environmental quality category.*

According to the regression tests, the factor with the highest mean (S2) is found to be proportionally affected by the category of Innovation. Also, through this part, the level of education correlates with the familiarity and importance of the green certification systems. Therefore, enhancing innovation and higher educational levels would have a positive influence on trust development in green building projects.

5. CONCLUSION

The importance of green building certification systems is increasing with the sustainability motion in the construction industry. Therefore, trust-related issues are arising for different certification systems. This study aims to find the crucial factors to increase trust for green building certification systems. Also, statistical analysis procedures are conducted to find the relationships between respondent profiles and the answers. This study conducted a literature research to explore the certification systems in use. Then trust related literature is examined to generate an appropriate trust framework for green building certification. Then, professionals that are participated in a major conference of green buildings are interviewed and an online questionnaire is distributed to the green building professionals with different backgrounds. Results indicated that system-based trust is of primary importance in green building certification, where establishing an effective communication platform is the paramount influence to trust. Also, the importance in educational level and familiarity with green building systems

are examined with different variables. Affect based trust is found relatively unimportant in trust establishment, where least important category is the regional priority in certification process. A limitation of this study is the relatively small sample, which was obtained after a convenience sampling process. Even though the respondents are familiar with the

topic and from 26 different cities of the world, the findings of the study cannot be generalized to the broader green building industry, nor to all green buildings. Future studies would have a broader perspective for trust considering the enablers and barriers to green certification systems and validate the findings in larger and different samples.

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Reflexivity as Individual Antecedent to Trust in Complex Project Setting

ABSTRACT

This paper addresses some concern about the increasing complexity of public funded projects, programs and portfolio in the public sector sphere. We argue that trust and collaboration should be a cornerstone of project success and innovation, through knowledge sharing between stakeholders. We go further, adopting an individual level advocating in favor of project manager's reflexivity as central to better engage with stakeholders which, in turn, would ultimately increase the benefits of public sectors projects. We draw insights from two previous field researches and propose the development of a preliminary instrument to assess reflexivity at individual level.

Keywords: Knowledge Sharing; Trust, Reflexivity; Instrument; Complex Project Setting

1. INTRODUCTION

The number of major projects is increasing worldwide, due to: (1) the technology that makes them possible; (2) the politics that favors them because they are very visible; (3) the economy that makes them attractive because they represent sources of earnings for different actors; and, finally, (4) aesthetics that turns them into strong symbols (Aubry *et al.*, 2017; Flyvbjerg, 2014). However, many issues remain salient in regard to the performance of major projects as the drifts in costs and deadlines continue to be the major problem since the 19th century (Flyvbjerg, 2014). The increasing complexity may partly explain this shortcoming. Project alliance literature indicates that the project delivery approach requires an entirely new set of behaviors and a new

framework of interaction based on trust (Mistry and Davis, 2009). Close relationships between all stakeholders and participants, from project design to delivery, which promote knowledge sharing are now imperatively promoted. Within this context, confidence and trust appear dominant (Walker and Lloyd-Walker, 2014) in the establishment of positive relationships between project stakeholders. Trust appears to be essential in building a climate promoting knowledge sharing between stakeholders (Ko, 2010; Leroux, 2015).

Our goal in this paper is to propose an emerging project – program or portfolio management soft competency that would allow public actors to better engage with stakeholders which, in turn, would foster trust and increase knowledge sharing... to ultimately increase public sectors project's benefits. (Keeys and Huemann, 2017).

This paper focus on reflexivity as an individual determinant of project managers in building a trusting relationship on the interplay between collaboration and knowledge sharing with stakeholders. We adopt a micro foundational view, thereby arguing for a better understanding of reflexivity as an individual determinant leading to trust and innovation in project management. Our interest is therefore situated on personal determinant facilitating the establishment of trust in interpersonal relations during all phases of a project occurring in complex setting. That being said, we hope to contribute in this IPMA research conference in paving the way toward a better understanding of personal characteristic beyond technical competencies which may contribute to the establishment of trust between project stakeholders. This first paper is directed toward a major project stakeholder, the project manager.

We first introduce the concept of knowledge sharing. Then, we try to trace back the determinants to achieve this collective endeavor drawing on empirical evidences from public and parapublic projects in a provincial government (Aubry et al, 2017) and in international cooperation project context (Leroux, 2015). Those research evidences lead us to propose reflexivity as promising avenue to enhance collaboration and trust in complex public project setting. Their underlying analysis led to a main evidence: determinants to project success go far beyond the technical competencies that we too easily put in priority (Bonache and Zarraga-Oberty, 2008) when looking for fulfilling a mandate. Leroux (2015) and Aubry *et al.* (2017) have tend to demonstrate both at an international level as well as at provincial public sector level that relational and managerial competencies could even hinder success if not displayed by actors. These results are coherent with previous studies (Eskerod, Hue-mann and Savage, 2015; Loufrani-Fedida and Missonier, 2015; Yap, Abdul-Rahman, Chen, 2017; Zuo, Zhao, Nguyen, Ma and Gao, 2018) advancing that the intertwined of all these competencies between actors involved in a project, program or portfolio are of upmost importance. Our aim is to propose and discuss on a measurement scale to assess project manager's individual reflexivity, arguing that this core competency would contribute to trust, collaboration and ultimately to public sector project success.

2. LITERATURE REVIEW

2.1 Knowledge sharing in project context

Knowdge sharing is not a new research theme in project management (Kaj and al., 2003; Mueller, 2012). The notions of sharing and exchange are similar. First, the notion of sharing refers to the relationship between individuals: "to the provision of task information and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures" (Wang and Noe, 2010: 117). In strategic management, knowledge sharing is a core activity through which employees can support innovation. Sharing would help reduce production costs, improve team performance, and create value. As for the notion of knowledge exchange, it can include an additional link to sharing; that of the party seeking information. We are in the presence of an information provider and an information seeker (Wang and Noe, 2010).

The term "transfer" in writing in knowledge management or organizational learning has been repeatedly defined. Szulanski (1996) defines it as "dyadic exchanges of organizational knowledge between a source and a recipient unit in which the identity of the recipient is important" (1996: 28). A few years later, Argote and Ingram (2000: 151) and Szulanski (2000: 10) defined the transfer in terms of process: "The process through which one unit (team, department, or division) is affected by the experience of another."

Therefore, "Knowledge transfer is a process in which an organization recreates and maintains a complex, causally ambiguous set of routines in a new setting" (Szulanski, 1996). Knowledge creation refers to a process that, taking place in the minds of individuals, consists of the formation of new ideas from interactions between tacit and explicit forms of knowledge. To achieve the level of organizational knowledge creation, there must be an amplification effect of the individually created knowledge that is then integrated into the organization's networks (Nonaka, 1994). The same process, where bidirectional exchanges occur between stakeholders, applies in a project or program where knowledge creation and innovation are closely intertwined. This is in line with the relational view of Doz and Santos (1997), which is a dialogue between two units, or a sender and a receiver. This exchange is influenced by their unique context and perspective, which potentially lead to innovation. It also echoes the collective capability concept (Orlikowski, 2002) and its underlying sensemaking and sense taking concepts (ref. Weick). Managing public projects, with all the aforementioned constraints and pressure, require from project managers to engage in this relational process of knowledge exchange, which has been underexplored by the project management community (Lehtonen and Martinsuo, 2008).

Finally, knowledge creation refers to a process that, taking place in the minds of individuals, consists of the formation of new ideas from interactions between tacit and explicit forms of knowledge. To achieve the level of organizational knowledge creation, there must be an amplification effect of the individually created knowledge that is then integrated into the organization's networks (Nonaka, 1994). The same process, where bidirectional exchanges occur between stakeholders, applies in a project-program where knowledge creation and innovation are closely intertwined.

2.2 The process of knowledge sharing and its results

In strategic management, the study of knowledge sharing is an extension of the resource-based theory. As such, Grant (1996) emphasized knowledge as a key strategic resource for the firm. In organizational learning, researchers also draw on resource-based theory to understand knowledge sharing and knowledge transfer (Argote and Ingram 2000; Argote, and al. 2000; Gupta and Govindarajan 2000). In project studies, knowledge transfer has been studied with different anchors. For example, Mueller (2012) look at knowledge sharing between project team members, while Aerts, Dooms and Haezendonk (2017) focused on knowledge transfer in PPP infrastructure projects. However, to our knowledge, few studies in public funded project and program has trace back the process to the individual determinants enhancing trust for knowledge sharing, thereby limiting our understanding to guide strategic human resources practices toward developing managers' competencies working in these specific complex environments.

2.3 Individual determinants to knowledge sharing

At the individual level, knowledge is acquired through different means. Experiential learning theory (Kolb, 1984) has influenced research in knowledge transfer. It combines elements of behavioral theories and cognitive theories. The experience, "coupled with cognitions, perceptions, and behaviors, reflects a holistic perspective of learning" (Kolb, 1984: 320). Here, learning is conceptualized in terms of process and not of result: learning is "the process by which knowledge is created by the transformation of experience" (Kolb, 1984: 38). Kolb identifies six premises to his theory: learning 1- is a process; 2- flows from experience; 3- requires the individual an ability to solve the dialectic between opposing demands; 4- is holistic and integrative; 5- requires the interaction between the individual and the environment; and 6- product of knowledge creation (Kayes, 2002).

This individual perspective of learning considers the dialectical relationship between the individual and his environment. In this context, the tension is twofold; on the one hand the dialectic between the subjective sphere of the individual and the environment. In other words, the new knowledge results from a transaction between the personal knowledge that the individual possesses *a priori* and the social knowledge

emanating from the environment. On the other hand, the individual faces the concrete-abstract duality (concrete aspect: what takes place during the experimentation or the implementation, abstract aspect: during the process when he is in observation and reflection modes). Through this double dialectic, the individual learns from his experiences and must use various skills.

Of course, many other individual determinants are linked to knowledge sharing and trust has a main condition. Characteristics such as education, work experience, personality, self-efficacy, motivation, and intention are some determinants identified in knowledge transfer literature (see the meta-analysis of Wang and Noe, 2010). For example, experienced employees who have a high level of education would be more likely to want to share their expertise with others. Thomas-Hunt and colleagues (2003) point out that recognition of the expertise of a team member increases participation in knowledge transfer. The disseminative capacity has also been studied (Wang and Noe, 2010, Minbaeva, 2007). It is not enough to demonstrate a capacity to transfer, the will seems to play a role (Wang, Tong, and Koh, 2004; Szulanski, 1996). Hamel (1991) had already included the same idea in his notion of strategic intentions in the context of inter-firm alliances. Aerts and al. (2017), also reported in their PPP infrastructure projects study that a lack of individual motivation for knowledge sharing hinder knowledge transfer. The motivational variables and the absorptive capacity of the parties may vary depending on the attributes of the actors involved in the transfer, and on the quality of their relationships. A recipient who does not trust the source, and vice versa, will not behave the same way as if he had an unwavering trust in the other stakeholder (Ko, 2010). Trust and cooperation between actors would positively affect the transfer of knowledge, and could be a potential source of social capital (Inkpen and Tsang, 2005). Leroux's results (2015) confirmed trust as a prerequisite to knowledge sharing in the context of public funded international cooperation projects. This relational determinant has long been identified as a barrier to project success (e.g. Diallo and Thuillier, 2007) in international development context. However, other themes emerged out of her study, as the need for competencies related to contextual sensitivity, empathy toward existing conditions and openness.

Public funded projects are complex and challenging. Past experiences show that stakeholders participation appears to

be a prerequisite to success and value creation. (Di Maddaloni and Davis, 2017; Keeys and Huemann, 2017; Eskerod, Huemann and Ringhofer, 2015; Mok, Shen and Yang, 2015). Although participation may take multiple forms, researches tend to demonstrate how individual level of reflexivity (Cunliffe, 2016; West and Anderson, 1996) would be beneficial to address many challenges.

2.3 One emerging competency in project management: Reflexivity

Also, Foujri and Coulombe's results (2016) shed light on reflexivity as an individual competency impacting two variables, namely project success and knowledge-sharing between project actors. Reflective practice allows the project manager to develop self-awareness and facilitates understanding of his role and the responsibilities of other stakeholders. It also contributes to empathy development (Foujri, 2014). In project management, the individual is brought to work in a complex environment characterized by a high degree of uncertainty, hence the need to train reflexive project managers able to adapt and learn from it is a key. Given this complexity, the manager with reflective and empathic skills is able to master better the socio-political context of the organization (Foujri, 2014; Winter, and al, 2006). According to Schön (1987), a reflexive practitioner must be able to adapt his way of doing things to complex situations by using his know-how and experience. Being in a continuous learning situation, the manager must be able to synchronize his reflexive skills with his actions (Schön, 1987).

We propose to explore this construct at individual level, trying to fill a gap in existing literature. The need to delve into project managers reflexivity may be a promising way in search for trust to promote innovative solutions within complex public funded projects.

The data that inspired the conceptualization of this paper emerge from two main research fields. The first research field is anchored within a 7 years program undertook in Haiti, between 2010 and 2017. Haiti is a major beneficiary of public aid, particularly from Canada. The 2010 post-seism emergency has placed this country as a priority for Canadian. Many initiatives are still implemented by international community. This research looks more closely into a program of technical cooperation financed by Canadian government and developed by a consortium of four Canadian NGOs that

were already known in the field. The second research field comes from public and parapublic provincial administration.

3. WHY NOT HAVING A TOOL TO ASSESS PROJECT MANAGER'S REFLEXIVITY?

Reflexivity is a multidimensional concept, which refers to notions that go beyond thinking about past events (MacCurtain and al. 2010). This vision echoes in studies in organizational learning where absorptive capacity has also been studied with reflexivity (Carter and West, 1998, West, 2000). It is also reflected in human resource management, where the concept of reflexivity has been mobilized as an individual and relational mechanism contributing to knowledge sharing (Monks and al., 2016).

Reflexivity refers to « the process of sense-making and construction of new shared meanings that questions the consolidated ways in which individuals give meaning to their realities. » (West, 2000 in Farnese, Feda and Livi, 2016:405). In this social perspective, innovation is the product of new insights from contextually interlinked interactions (Monks and al., 2016). The so-called reflexive practice is inevitably conceived as a dialogical and relational activity. The reflexivity of the actors would contribute to behavioral outputs, disrupting with conventional practices or taken for granted ideas, thus promoting rupture and innovation (Curado and al., 2017; Cunliffe and Easterby-Smith, 2004)

In the management field, reflexivity would contribute to organizational innovation, adapting itself to the pressures of external environments (West and Sacramento, 2006). Scholars study reflexivity at organizational (Farnese and Livi, 2016; Gorli and Niccolini, 2015) and team (Andela and Truchot, 2017; Chen and al., 2016) levels. Taken together, studies converge to demonstrate that reflexivity is linked to organizational innovation as well as team performance. It is also postulated that reflexivity is an individual mechanism of knowledge sharing (Minbaeva, Mökelö, and Rabbiosi, 2012). To our knowledge, in project management, reflexivity is mainly studied at the team level to demonstrate its impact on team effectiveness (Elbana, 2015; Hoegl and Parboteeah, 2006) and innovation (Dayan and Basarir, 2010; Lee, 2008). We therefore address partly this gap by exploring how to assess reflexivity at individual level.

3.1 Individual – Project managers reflexivity

Being reflexive for a project manager in public funded projects and programs “is a way of being in relation with others that brings with it moral and ethical considerations. It requires us to be solicitous and respectful of differences.” (Cunliffe, 2016: 745) That being said, this implies from the project manager to adopt managerial practices that go beyond mastering techniques and tools specific to the field. This refers to human and relational skills that promote trust, collaboration and knowledge sharing with all stakeholders, despite additional resources and time needed to achieve a successful process. According to Schneider (2015), stakeholders consideration contributes to results as well as the balance between corporate objectives and sustainable development objectives. Considering the above, we argue that in public funded projects, a project manager’s reflexivity should figure as a high ranked competency, helping to establish a trusting climate, thus enhancing collaboration to achieve sustainable innovation.

Being a reflexive project manager could lead to many upsides, but it also requires to understand the main challenges and barriers to perform reflexivity in this complex and stressful context. As pointed out by Farnese and al. (2016) in their study in the field of innovation, the adoption of reflective practices requires more effort in terms of time and energy. Sometimes, pressures contribute to what Gurtner and al. (2007) call cognitive inertia factors, limiting reflective practice to the benefit of productivity. This argument should not limit the development of the practice in the management of public projects. On the contrary, the development of this meta-competency is inextricably linked with the awareness of the multiple forces against the change, or the taken for granted True. To achieve this end, a change is expected in the ecosystem, positively interpreted and following Giddens’s social perspective (1991) (taken in London and Siva, 2011).

3.2 Reflexivity in project management

London and Siva (2011), studying mega projects in the construction industry, have proposed an organizational model of reflexive capacity in which they decline reflexivity in three dimensions. 1- awareness, 2- responsiveness and 3- adaptability. As mentioned, studies have more looked at team reflexivity (Schippers, West and Dawson, 2015; Schippers et al., 2007; West, 2000). However, in the context of

public projects where innovation is expected, the manager’s reflexivity should be evaluated in his multiple social interactions, beyond the scope of its project team. As West (2000) points out, reflexivity manifests itself in many behaviors: “... behaviors such as questioning, planning, exploratory learning, analysis, diverse exploration, making use of knowledge explicitly, planning, learning at a meta-level, reviewing past events with self-awareness, and coming to terms with new awareness” (p.4). This description matches with dimensions proposed by London and Siva (2011). At the project manager level, we define awareness as the manager’s increased sensitivity to external information and knowledge, where he can confront his assumptions with new avenues to examine a situation or a problem (Hoegl and Parboteeah, 2006). Responsiveness is reflected in the manager’s openness to different, and sometimes conflicting visions, thereby looking for collaborative opportunity with all stakeholders. Finally, we translate adaptability through its capacity to adapt its practices in the search for coherence and strategic alignment between its actions, project activities to perform, and the main project objectives to be achieved.

We partly build on Carter and West (1998), and Hoegl and Parboteeah, (2006) team reflexivity scales to propose a project manager reflexivity scale. Adaptations to existing tools are made. First, and as stated, the majority of reflexivity scale assess the team level. Secondly, it appears that the majority of the instruments conceive reflexivity as unidimensional construct, whereas according to the socio-constructivist perspective on innovation, three sub-dimensions have been proposed, namely awareness, responsiveness and adaptability, which are also personal indicators influencing trust in the relational dimension of knowledge sharing (Leroux, 2015). Finally, and more importantly, according to our knowledge, all instruments identified in specialized project management studies seem to focus on the implementation of the project, regardless of the front-end processes, so decisive on back end results of public projects (Cha and al. 2018).

Carter and West (1998) developed a team reflexivity scale based on 16 items and a 7-points Likert scale. They propose the construct with two factors: task reflexivity and social reflexivity. Task reflexivity covers the following items: The team often reviews its objectives; The methods used by the team to get the job done are often discussed; We regularly discuss whether the team is working effectively together; In this team, we modify our objectives in the light of changing

circumstance; Team strategies are rarely changed; How well we communicate information is often discussed; This team often reviews its approach to getting the job done; The way decisions are made in this team is rarely altered.

The second dimension, social reflexivity consists in: Team members provide each other with support when times are difficult; When things at work are stressful, the team is not very supportive; Conflict tends to linger in this team; People in this team often teach each other new skills; Conflicts are constructively dealt with in this team; When things at work are stressful, we pull together as a team; Team members are often unfriendly; People in this team are slow to resolve arguments.

Hoegl and Parboteeah (2006) propose four variables in their questionnaire on team reflexivity:

V1: The team investigated and observed the context and the progress of our project (e.g., task performance strategies, goals, project requirements, the organizational context, etc.).

V2: The team adjusted its task performance strategies in response to changes in the context and progress of the project.

V3: The team spent an adequate amount of time considering the likely consequences of its task activities (e.g. considerations regarding usability of the product, compatibility with other products, cost)

V4: Strategies and work approaches chosen were later checked for their appropriateness by the team.

3.3 En route toward the development and validation instrument assessing project manager's reflexivity

As mentioned above, we need to adapt the reflexivity construct to the individual project manager's level. As such, the challenge is to capture items and translate them with indicators reflecting the complex environment wherein project manager evolves. Our proposed methodology is presented following a sequential approach to scale development leading to the validation of the constructs and the

reliability of the measurements (Brousselle, Champagne, Contandriopoulos and Hartz, 2011). The aim is to provide an instrument suited to the context of project management which assesses reflexivity as individual skill.

A sequential approach (Bourgault, Gallagher, Michaud, and St-Cyr, 2010) using a mixed methodology is used. Our literature review has defined our concept and dimensions. Next, we, defined the items to adjust them to the project manager's reality (Lewis, Templeton and Byrd, 2005; Carpenter, 2018). This step is to be carried out through semi-structured interviews followed by focus groups. Once the adjustment has been made following the approach proposed by Lewis, Templeton and Byrd (2005), the pre-test will be conducted with a first project managers sample that will answer the questionnaire. This pre-test will assess the reliability and the validity of the proposed concept. Following revisions to the questionnaire, the pilot test will be conducted to test the instrument (Lewis *et al.*, 2005). This step will improve the quality of the database as well as the robustness of the instruments. (Beavers, Lounsbury, Richards, Huck, Skolits and Esquivel, 2013; Carpenter, 2018). The administration of the questionnaire will be carried out within the Quebec Public Service project managers as a first step. Common factors analysis (Pituch and Stevens, 2016; Tabachnick and Fidell, 2017) will be used to test whether reflexivity construct is a structure that can be theoretically validated for the project manager population. Two tests will confirm the possibility to complete data processing (Kaiser-Meyer-Olkin and Barlett's test)(Lewis *et al.*, 2005), before performing exploratory factor analysis. These tests will assess the validity. Reliability will be analyzed (internal consistency of the tool) with Cronbach's alpha, according to the descriptive and correlational analyzes. By iteration, the number of factors that emerge for the construct will be adjusted until a measure of internal consistency is found acceptable. (Lewis *et al.*, 2005; Tabachnick and Fidell, 2007). These analyzes will be carried out before conducting the confirmatory analyzes through structural equation technique. This last stage of the research is essentially aimed at testing the validity of the reflexivity construct (Pituch and Stevens, 2016).

The proposed project manager's reflexivity items derived from Carter and West (1998; see also Schippers *et al.*, 2003) and Hoegl and Parboteeah (2006). Here are as follow: I always reflect on the way I manage my projects; I always think whether better alternatives and options exist for the choices

I've made; I often exchange in deep-level conversation with project stakeholders and review accordingly my project's objectives; The methods I use as a project manager to reach project's goals are often discuss with stakeholders; In my project management role, I can and do modify project's objectives in light of changing environment, context, barriers and opportunities; I'm used to adjust task performance in response to changes in the context and progress of the project; I spend an adequate time considering the likely consequences of my project plan and it's compatibility with desired outcome; I always take time to analyze my decisions; Strategies chosen within my project mandate are later assessed for their suitability within the context.

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Concluding remark

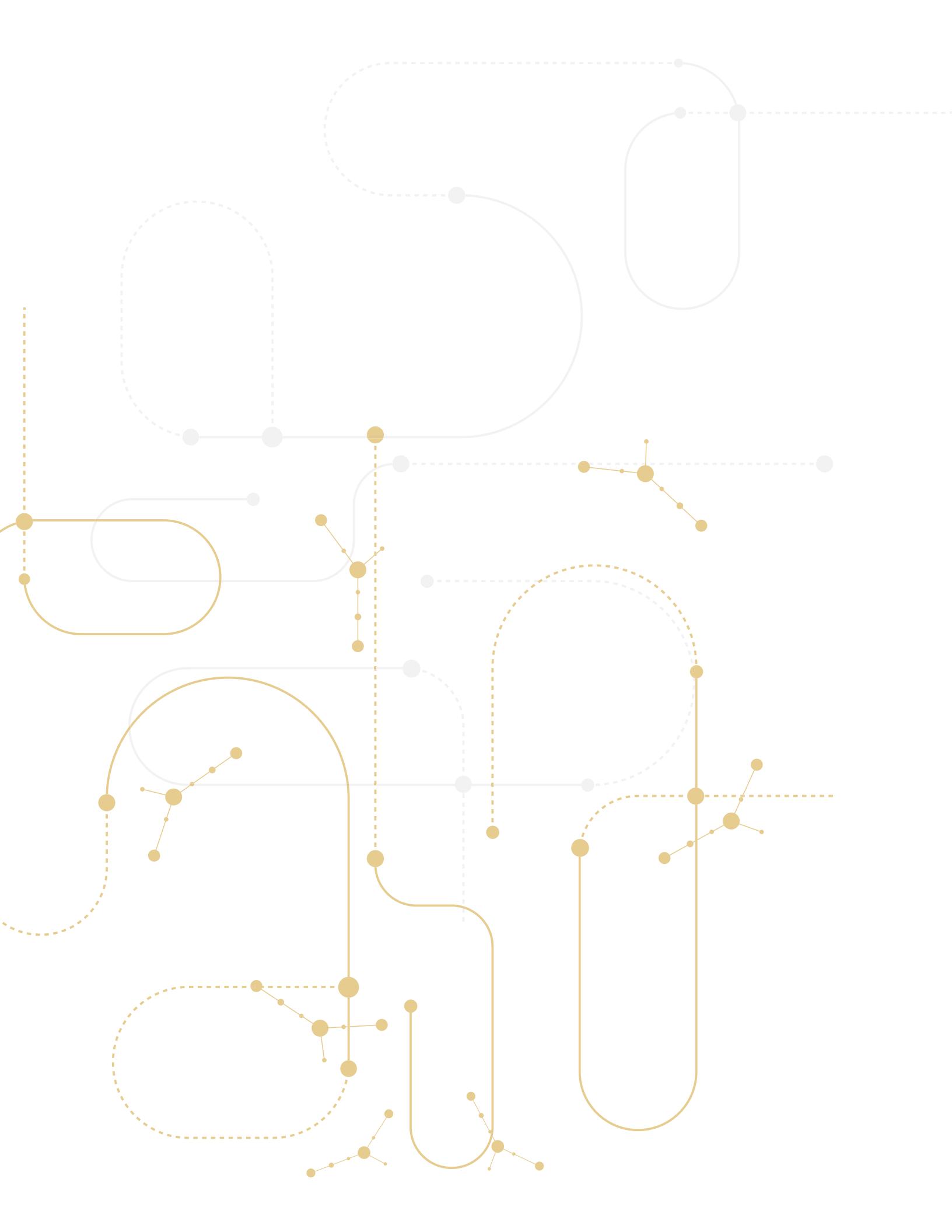
As mentioned in the introduction, increasing pressure on our governmental entities in search for value creation in this digital economy lead to constant pressure and tension momentum that is perceptible when one is working close to governmental actors. We aim, through the development of a reflexivity scale adapted to project managers working in complex setting, to help them delving into their self and adopt a posture that would enhance their authenticity and openness, thus fostering trust which would positively impact project success. We therefore pursue this assumption in order to fill a gap in the literature with the specific objective to uncover personal attributes/competency that can promote trust and collaboration toward increasing success chances in complex project setting.

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History, Trust and Mistrust: Lessons From Radioactive Waste Disposal Megaprojects

ABSTRACT

High-level nuclear waste repository projects are unique megaprojects: they are to provide a local solution to a national/global problem, entail exceptional intergenerational justice considerations and multiple interests of the state. As such, repository projects exhibit particular trust and mistrust problems and dynamics. This paper examines in particular the role of public trust in institutions – in the first hand those responsible for NWM, but also trust in institutions of society more generally – as a key element conditioning the success of repository projects. It focuses on three themes: historical legacies, interaction between various dimensions of trust and mistrust, and the potential virtues of mistrust. The paper discusses the importance of these themes via illustrative examples from repository projects in three forerunner countries – Finland, France, and Sweden – and the UK as a contrasting case of failed yet elaborate trust-building efforts. The historical evolution of trust-mistrust relations have facilitated trust-building in Finland and Sweden, but hindered them in France and the UK. These historically shaped trust-building efforts have been conditioned by interpersonal (social) trust relations, but in particular by ideological trust and mistrust relating to broader institutions of society, such as the legitimate roles of market and the state. Success in governing megaprojects will require greater attention to the mutual interaction between trust and mistrust, in particular the virtues of ‘healthy mistrust’ via ‘civic vigilance’.

Keywords: Nuclear Waste; Dimensions of Trust; Virtues of Mistrust; Civic Vigilance; Social Acceptance

1. INTRODUCTION

Despite almost half a decade of intensive efforts, the unresolved “waste problem” – what to do with the high-level radioactive waste – still constitutes a major impediment to nuclear new-build. Burial in deep geological repositories represents the “reference option” for international and national organisations responsible for nuclear waste management (NWM), yet no such repository is operational yet. Apart from the as such formidable engineering task of constructing a safe repository, the key challenge facing these projects is that of identifying local communities with adequate geological conditions and willing to host such facilities. Site investigations in many countries have, one after another since the late 1980s, stalled in the face of vehement local opposition. Since the early 1990s, industry and public authorities have sought to implement more participatory approaches in order to earn *social acceptance* or a “social licence to operate” (SLO) for their repository projects (e.g. Sundqvist & Elam 2010). From project management perspective, participation has been a major means whereby project owners and promoters seek to strategically manage their external stakeholders, including notably community activists, media, advocacy groups and other non-governmental organisations (e.g. Freeman, 1999; Aaltonen and Kujala 2010). Earning public trust and confidence in the repository concept, in the actors involved, and in the process has become a major objective when organisations deal with external stakeholders and seek social acceptance. The strategies employed by these organisations for stakeholder management, in turn, crucially affect their trust relationships with external stakeholders. Strategies entailing

compromise through balancing, pacifying and bargaining with external constituents would appear, a priori, the most susceptible to engender trust, yet alternative options of acquiescence, avoidance, defiance and outright manipulation (Olivier 1991) are common, and would risk generating increasing mistrust.

Repository projects are in many ways unique as megaprojects. Most fundamentally, these projects are not designed in the first hand to generate profit or national, regional and local socioeconomic development, but to provide a local solution to a national – even a global – problem (e.g. Lehtonen *et al.* 2017a). When weighing the costs of these projects against their benefits, the benefit side is therefore in a way prefixed. Second, radioactive waste needs to be isolated from living organisms for up to 100 000 years, which greatly complicates the arbitrations between the local, national and global interests, and accentuates intergenerational justice considerations. Third, the state is involved in NWM policy in ways that are more profound and multiple than in most other megaprojects. This follows from the distinct patterns of economic interests involved, in particular the close ties between nuclear energy policy and NWM, and from the contentious nature of nuclear power. The industry was initially born to support the production of nuclear weapons, and has, even in the most economically liberal countries, received crucial support via R&D, communication and knowledge-creation, regulation, and direct and indirect economic and institutional assistance. The unresolved ‘waste problem’ therefore continues to haunt a dense network of partly transnational links between the industry, government institutions, local and national politicians, taxpayers and voters. Fourthly, and crucially for this paper, NWM actors have since a long time recognised the vital importance of issues of trust and mistrust. Efforts to identify willing hosts for waste repositories have suffered from the tradition of opacity and secrecy that have characterised nuclear industry, as well as from the technocratic and non-inclusive processes of site selection that prevailed in the 1980s and 1990s. The creation of the Forum on Stakeholder Confidence (FSC) under the OECD Nuclear Energy Agency (NEA) in 2000 epitomises the realisation of the importance of building trust and confidence if NWM policy was to advance. Trust-building has, indeed, become somewhat of a ‘silver bullet’, believed to solve what are typically framed as problems of public acceptance and acceptability.

Most trust-related megaproject management literature has focused on the inter-firm partnerships and alliances or interpersonal trust within firms (e.g. Lau and Rowlinson, 2009; Maurer, 2010). By contrast, this paper concentrates on institutional trust. It starts from the assumption that public trust in institutions – in the first hand those responsible for NWM, but also trust in institutions of society more generally – is indispensable for successful NWM policies. However, this paper makes three claims, which it seeks to illustrate via examples from NWM policy in four European countries: Finland, France, Sweden, and the UK. First, I will demonstrate that **institutional trust is closely interwoven not only with interpersonal (social) trust relations, but also with ideological trust**, that is, citizens’ trust in broader and more abstract ideas relating to the legitimate roles of various institutions in society. In NWM, ideological battles over nuclear power further accentuate the importance of ideological trust. Second, I will illustrate the various ways in which these interactions affecting NWM policies are shaped by the **country- and context-specific histories** of the projects in question – within specific ‘cultures of trust’ or ‘regimes of trust’. The attention to context also aligns with observations from recent stakeholder management literature: an individual project is not necessarily the major concern for stakeholders, who operate in the framework of their own stakeholder relationships and historically formed coalitions, which often have powerful impact on the project (Eskerod *et al.* 2015). Third, I will argue that the focus on ‘building’ trust has tended to conceal the multiple **virtues of mistrust** – in the form of ‘healthy’ mistrust towards those in power and hence a foundation of liberal democracy, but also as civil society activity, in the form of “civic vigilance” (Laurian 2009).

Finland, France, and Sweden are internationally considered as the three leading countries in repository development, with project in the course or near implementation. The UK provides a contrasting case, with a history of failed efforts to generate consensus and find a willing host community, despite the extensive trust-building efforts. The case selection allows contrasting the Nordic high-trust societies with the low-to-medium trust contexts in France and the UK. The long experience of trust-building and mistrust in the NWM area can provide useful lessons to megaproject management, by highlighting the vital role of institutional trust. This type of trust is indispensable not only for nuclear

waste repository projects, but arguably for megaprojects more generally.

The illustrative examples presented in this paper come from two main sources. First, I will use the material produced within the recently finalised Euratom-funded HoNESt project (History of Nuclear Energy and Society), which explored interaction between the nuclear sector and society in 19 European countries and in the USA. Second, I will draw on the extensive work by myself and my colleagues concerning NWM and nuclear energy in the four case study countries (e.g. Kojo 2009; Kojo & Kari 2010; Teräväinen *et al.* 2011; Kojo & Richardson 2012; Kojo *et al.* 2010; 2012; Lehtonen 2010a; 2010b; 2015; Lehtonen *et al.* 2017a; 2017b; Lehtonen & Kojo 2019; Litmanen *et al.* 2017; Vihunen *et al.* 2019; Kari *et al.* 2010; 2019). This work included semi-structured interviews conducted mainly between 2009 and 2016 with key actors involved in the nuclear waste policy of the four countries at the national, regional and local levels (e.g. local and national-level politicians and authorities, civil society, the nuclear industry and waste management organisations, and academic researchers).

The next section outlines the key concepts employed: social, institutional and ideological trust and mistrust. Section three briefly presents the NWM policies in the four case study countries. Section four examines this experience in light of the above-mentioned three key topics of the paper. Section five concludes.

2. CONCEPTUAL FRAMEWORK

In scholarly literature as well as in everyday usage trust is almost invariably portrayed in positive terms. Research has shown its value for a wide range of economic and social processes: interpersonal relations and economic exchange (Dasgupta 1988), financial investments (Kalkbrenner and Roosen 2016, 62), the legitimacy of political power (Tait 2011), societal and economic development and growth (Gallucio 2018), innovation, education, rule of law, good governance, reduction of corruption and violence, well as subjective well-being (Zak and Knack 2001; Laurent 2009, 14; Volland 2017), environmental performance and the propensity to adopt strict environmental policies (e.g. Owen and Videras 2008; Tjernström and Tietenberg 2008; Carattini *et al.* 2015).

2.1 The three dimensions of trust and mistrust

We define **trust**¹ as a stance whereby an individual accepts ‘believing without knowing’, thereby placing herself voluntarily in a position of vulnerability towards ‘the other’, be it another individual or an institution² (Earle and Siegrist, 2006). There is always a risk that the ‘trustee’ proves untrustworthy, yet as a voluntary choice, trust does not have to imply the feeling of loss power and control (Espluga *et al.* 2009).

Social trust is interpersonal. It can be further divided into **generalised** trust in other, unknown, members of society (Rothstein and Stolle, 2008) and **particularised (specific)** trust in people we already know, with whom we interact regularly, for example in our own social or demographic group (Bäck and Christensen, 2016, p. 180).

The main focus here is on **institutional trust** – the public trust in key institutions involved in NWM, such as nuclear safety authorities, the government, nuclear operators, government regulation, and environmental organisations. Institutional trust can entail **specific support** for a given institution or organisation, or **diffuse support** for the system as a whole (Kestilä-Kekkonen and Söderlund 2016, 141; Lehtonen and de Carlo, 2019). The former typically derives from individuals’ judgement of what an institution *does* (its performance), whereas diffuse support springs from what an institution represents for the individual – what it *is* (*ibid.*). For example, trust in the present government coalition would constitute specific institutional trust, whereas trust in the “British government” would represent a diffuse form of institutional trust. To earn trust, an institution needs to demonstrate competence, sincerity, transparency, reliability in keeping its promises, proven ability to deal with mistrust and avoid mismanagement or entanglement in political

1 For the sake of simplicity, we use the term trust to encompass both its traditional meaning as a normative judgement concerning an individual or entity, and confidence, that is, a belief based on earlier experience that certain events will occur as predicted (Earle and Siegrist, 2006; Luhmann, 2006; Kinsella 2016).

2 Following Hodgson (2006, 18), we define institutions broadly, as “systems of established and embedded social rules that structure social interactions”. Organisations, in turn, are a specific type of institution.

scandals (Holmberg and Weibull 2017, 39; Laurian, 2009, p. 383-384; Tuler and Kasperson, 2010). In situations of long-standing institutional mistrust, attempts at trust-building via participation and openness can initially undermine trust (Gouldson *et al.*, 2007; Laurian, 2009).

The concept of **ideological trust** relates to higher-level institutions, such as democracy, the state, market, and planning, and their legitimate roles in society (Tait, 2011, 158). As a more abstract form of trust, it is difficult to capture via quantitative surveys. Ideology is here understood as a scheme of interpretation of reality, which relates to means-ends relationships and strategies (Söderbaum 1999), i.e. to "wider abstract systems and ideas", such as economic growth models, the legitimate role of government in intervening in the economy (Tait 2011, 160), technological optimism, the precautionary principle, centralised or decentralised solutions (Söderbaum 1999, 163), or the legitimacy of nuclear power as an electricity-generating option. Trust in specific individuals and institutions is ultimately embedded in trust concerning these wider and more abstract ideological elements. What distinguishes ideological trust from social and institutional trust is that it "transcends information" (Tait 2010, 160), that is, ideological trust is not based on previous evidence or knowledge, but "on an individual's or institution's place within wider social discursive structures" (*ibid.*; see also Lehtonen and de Carlo, forthcoming). However, in longer term, ideological trust can be gradually

shaped by our experience from interpersonal interaction and trustworthiness of institutions.

2.2 Downsides of trust and virtues of mistrust

Trust has its downsides. Goel *et al.* (2005, 203) mentions three harmful consequences from "overtrust": leniency in judging the trustee, delay in perceiving exploitation, and increased risk-taking. 'Bonding social capital' can feed exclusion, homogeneous social networks, specific norms of reciprocity, groupthink, the exclusion of different yet competent others, and creation of sharp boundaries between 'insiders' and 'outsiders' (Laurent, 2009; van Deth and Zmerli, 2010; Kujala *et al.* 2016, 702). Trustful citizens may lack the motivation to participate in planning and decision-making, preferring instead to delegate power to trusted experts and institutions (Parkins and Mitchell, 2005, 536).

Ultimately, as 'healthy suspicion', mistrust towards the powers that be constitutes a foundation for the vitality of a democratic system – a form of "civic vigilance" (Laurian 2009), responsibility, and countervailing power that helps citizens to hold political, economic and cultural elites to account (Warren, 1999, 310; Laurent 2009, 27; Allard *et al.* 2016, 14). Organisations and procedures of regulation (e.g. auditing, evaluation, ranking, and benchmarking) represent an institutionalised form of mistrust and vigilance (van Deth and Zmerli 2010, 2665).

Table 1. Summary of the key concepts relating to trust and mistrust

Type of trust/mistrust	Social	Institutional	Ideological
Description	Generalised Particularised	Diffuse support Specific support	Legitimacy of and support to meta-level institutions
Sources of trust	Competence Sincerity		Worldviews, visions
	Normative predisposition in relation to an institution or an individual (trust)		
	Predictability, based on previous experience (confidence)		

2.3 Measures for building trust and feeding mistrust

NWM actors (industry, governments, government experts) typically stress the importance of public trust as an essential prerequisite of successful RWM. The technical and scientific analyses and design of the waste disposal solution constitutes the most fundamental trust-building measure (e.g. Elam *et al.* 2010). This paper focuses on the non-technological **trust-building measures**, in the first hand on **those designed to strengthen trust in institutions**. Four categories of measures are particularly relevant in NWM: 1) voluntary opt-in and opt-out, i.e. voluntary engagement by the community and the possibility to withdraw from the siting process; 2) participatory governance approaches; 3) economic support, including notably the community benefit schemes; and 4) the creation of independent bodies of control and oversight.

Civil society actors critical towards RWM policy, in turn, seek to build mistrust – towards institutions via various campaigning strategies such as by disseminating critical information or by revealing cases of mismanagement or even corruption. They further employ means of undermining ideological trust, via criticising nuclear power as an energy supply solution or, for example, criticising what they see as undue involvement of the private sector in governing nuclear energy and RWM policy.

3. BUILDING TRUST AND MISTRUST IN NWM IN FOUR CASE STUDY COUNTRIES

This section briefly describes the evolution of NWM policy in the four case study countries, in particular from the perspective of dynamics of trust and mistrust. Surveys consistently show exceptionally high levels of interpersonal and institutional trust in Finland and Sweden, whereas France and the UK are situated at an average European level (OECD, 2013, 30; Delhey 2011). However, while evidence for such a general observation seems robust, opinion surveys more specifically focused on NWM policy sometimes give ambiguous if not contradictory results, depending notably on the framing of the questions. For example, a 2007 Eurobarometer study concerning nuclear safety, 48% of the British trusted that nuclear waste could be disposed of safely – a figure only two

percentage points lower than in Sweden, slightly higher than in Finland (45%), and far above that of the 26% in France (Eurobarometer, 2007, 29). However, a similar survey, conducted only a year later, but this time focused on NWM, suggested much higher scepticism concerning the possibility of safe disposal of waste: more than 80% of Finnish, Swedish and French citizens largely or totally agreed that there was “no safe way of getting rid of high-level of radioactive waste”, while only 66% UK citizens expressed this kind of scepticism (Eurobarometer, 2008, 27–28). Interpreting the four cases in light of the three key themes of this article hence requires going beyond mere opinion survey data, and specific attention to the historical evolution of trust and mistrust relationships, within the country- and case-specific contexts.

3.1 Finland

In 1978, the nuclear power operators – the state electricity company IVO (today, Fortum Power and Heat Ltd), and the private TVO – were made legally responsible for managing their waste. Operating two reactors of Soviet origin, IVO exported its waste to the USSR, whereas TVO sought a national solution for its waste problem. The highly technical approach to site selection generated local opposition in the late 1980s and early 1990s, and pushed TVO to gradually increase the involvement of citizens in the process (Kojo 2009). Two legislative decisions in 1994 triggered a participatory turn: banning of nuclear waste exports as of 1996, and the Environmental Impact Assessment (EIA) Act, which rendered EIA mandatory. To prepare the construction of a repository, TVO and Fortum set up a joint waste management company, Posiva, which engaged in an exceptionally long and thorough participatory EIA process in 1997–1999. Critics described the EIA as mainly ‘theatre play’ with little impact on decisions (e.g. Rosenberg 2007; Hokkanen 2008; Strauss 2010). Four municipalities were considered, but Posiva had already shifted its focus to the country’s two nuclear municipalities – Loviisa and Eurajoki – where it expected to face little resistance. In 2000, Eurajoki municipal council gave its approval, and thereby allowed Parliament to approve in 2001 a government Decision-in-Principle with votes 159–3 for the construction of a rock characterisation facility (ONKALO), eventually to become a repository. A year later, Parliament approved the construction of a new nuclear reactor in Olkiluoto. Construction of ONKALO began in 2004, following the Swedish KBS-3 concept, in granitic host

rock. In 2015, the government granted Posiva a construction licence for the repository, which employs the Swedish KBS-3 concept of deep disposal in granite bedrock. Posiva, hopes to start disposing of spent nuclear fuel (SNF) in Olkiluoto, in the municipality of Eurajoki, in 2024, only slightly behind the schedule set out in a 1983 government decision.

The government today holds about 52% of the shares of Fortum, whose key areas of activity are in the Nordic and Baltic countries, Poland, Russia, and India. TVO is owned by a consortium of power and industrial companies, with Pohjolan Voima and Fortum as its largest shareholders. The Ministry of Economic Affairs and Employment is responsible for policy planning and coordination (including in the processes of Environmental Impact Assessment, EIA), the safety authority (STUK) acts as the main regulatory body, the highly autonomous municipalities constitute the key local-level actors, while Parliament approval is required for the project to go ahead.

In international arenas, Finland is often portrayed as an exemplary case of democratic and consensual governance of RWM, whose disposal project has advanced without generating hardly any overt citizen opposition, allegedly owing to careful long-term preparation and consistent implementation of the government strategy from 1983 (e.g. Vira 2006; Kojo 2009; Lehtonen *et al.* 2017b). This consistency has indeed helped to generate trust in the policy actors, not least amongst the nuclear power companies.

The Finnish case has been characterised by near-absence of overt public opposition, although surveys show relatively low trust in repository safety amongst citizens in Eurajoki (41%) and nationally (36%). Only 57% of Eurajoki residents trust in the reliability of information provided by Posiva. However, this modest level of trust seems to be compensated by exceptionally strong (82%) trust, both nationally and in Eurajoki, in the nuclear safety regulator as source of information on nuclear-related issues (Vilhunen *et al.* 2019; Energiateollisuus 2018). In its partnerships with the nuclear industry, the municipality has adopted somewhat of a position of a ‘bystander’, willing to fully delegate safety review of the project to the safety authority, and primarily tending to its economic interests.

The Finnish case carries features of **pragmatic trust**: the repository project appears as inevitable, albeit an outcome of a legally correct process.

3.2 France

The French project has a long and conflict-ridden history (e.g. Blowers 2016). In line with the state-driven nuclear policy in France, the government created in 1979 the National Radioactive Waste Management Agency (Andra) to implement geological disposal. Andra’s initial site investigations in the late 1980s generated vehement local opposition. To unblock the subsequent stalemate, the government reopened the search in 1991 to include three different RWM options, and opened the discussion to a wide range of actors (Barthe 2006). Towards the late 1990s, local conflict aggravated again, in the context of declining public trust in the governance of risk³, and following government decision to designate as a site for an underground research laboratory (URL) Bure – a small village in a remote, rural, sparsely populated, and socio-economically declining region in the east of France. The other sites eliminated one by one, Bure soon became the *de facto* only candidate for hosting a repository (Blowers 2016). The fifteen-year period of ‘opening up’ inaugurated in 1991 culminated in a mandatory public debate organised in 2005-06 by the National Commission on Public Debate (CNDP). Even many opponents considered that the Commission had succeeded in resisting pressures from vested interests, protecting its own integrity, and bringing new perspectives to the debate (GC 2006, 64).

The planned repository, Cigéo⁴, to be built in clay host rock, would host the high- and medium-level waste from the 58 reactors currently supplying over 70% of France’s electricity consumption. Andra plans to start construction in 2022 and operations in 2030. The financing for the project comes via taxes levied on the largely state-owned waste producers: EDF, Orano (until late 2017 Areva), and the national nuclear

3 Including the widespread perception that the government had sought to conceal the true extent of Chernobyl fallout in France (Lehtonen 2018).

4 Centre industriel de stockage géologique.

R&D agency, CEA⁵. The nuclear sector enjoys a special place among state interests, as a major export sector, a key actor in the modernisation of the country since the 1950s, and a source of national pride (Hecht 2009).

Although supported by most parliamentarians, departmental authorities, business organisations, trade unions, and local mayors (CNDP 2014, 7), the project continues to generate controversy. Only a handful of mayors of the numerous small rural communes in the immediate vicinity of the installation oppose the project, yet radical contestation by local and national activists has intensified recently, and has led to clashes between the police and the demonstrators.

Only 5-6%⁶ of the French population would agree to live near a nuclear waste repository (IRSN, 2017, 94-95), yet 78% of the local population trusts in the safety of the repository and 63% trust in Andra as a source of information on the project (Ifop, 2016, 6). National-level surveys reveal a discrepancy between the strong (76.5%) trust in the competence of safety authorities and a relatively low trust in their sincerity in telling the truth of nuclear risks (40% for ASN and 57% for IRSN) (IRSN, 2017, 129).⁷

The French case could be described as one of ‘resigned trust’, characterised by ideological trust in the state, deep-seated reciprocal institutional mistrust, resignation of local actors in the face of state decisions, and perception of the repository project as the ‘only hope’ for an economically declining region.

3.3 Sweden

In 1977, nuclear law obligated the nuclear operators to demonstrate a “totally safe” solution to the waste problem, as a precondition for new reactor licencing. After a nine-month period of intensive research, the power companies

came up with the so-called KBS⁸ method. In 1981, they created a joint company (first SKBF; today SKB) to develop and implement the solution. SKB is owned by the 100% state-owned Vattenfall, Forsmarks Kraftgrupp AB (with Vattenfall as a majority owner), OKG Aktiebolag, and E.ON. The Finnish mostly state-owned Fortum owns shares in Swedish nuclear power stations, while other Swedish companies owning shares in the country’s nuclear plants are Fortum’s subsidiaries.⁹ Sweden was one of the early adopters of nuclear power, and the industry has played a significant role in the country’s economy. Following a referendum in 1980, the government committed to phasing out nuclear power, yet the schedule has been repeatedly delayed. Eight nuclear reactors today provide about 35% of the country’s electricity. The governance structure resembles that of Finland, with strong municipal autonomy as a founding pillar, yet unlike in Finland, the provincial authorities have a coordinating role in EIA, and the licencing system entails two “tracks” – one based on the Nuclear Activities Act, and another on the Environmental Code.

SKB’s initial search for a willing site proved unsuccessful in the face of public opposition (Sundqvist, 2002). In 1993–2000, it conducted feasibility studies in eight municipalities. Like Posiva, SKB ended up concentrating its efforts on nuclear communities, of which Oskarshamn and Östhammar proved to be the most eager to engage (*ibid.*). Like in Finland, the host municipalities are prosperous nuclear communities (hosting nuclear power stations and low-to-medium level waste repositories), where the local nuclear industry appears as a trusted employer and partner. With a largely favourable local opinion, the municipalities engaged in competition for the repository project. In 2009, SKB chose Östhammar as the repository site, while Oskarshamn would receive the encapsulation plant. SKB submitted a construction licence application in 2011, yet the final decision is still pending, notably because of doubts concerning the corrosion rate of the copper-clad waste containers, and the financing of the facility. Perhaps even more so than its Finnish counterpart, the Swedish example is internationally described as a model for democratic and dialogical planning and decision-making (Cotton 2017, 17).

5 The French state owns over 80% of the shares of EDF, the operator of France’s 58 nuclear reactors, and more than 90% of those of the full-fuel-cycle nuclear company, Orano.

6 Percentage of those accepting to live near a radwaste disposal facility. The figure declined from about 12% in mid-1980s, to the present level in 1987-88.

7 Trust that these organisations tell the truth about the nuclear issues.

8 Kärnbränslesäkerhet (engl. Nuclear Fuel Safety).

9 For example, Värmlandskraft OKG-delägarna, Mellansvensk kraft group.

Trust in the safety of the disposal project is stronger than in Finland, both nationally – 73% in short-term safety and 54% in long-term safety (Hedberg, P. & Holmberg, S. 2018) – and locally (86%) (Demoskop 2017). The locals seem to hold significant trust in SKB (76%), while only 61% of Östhammar residents trust in the regulator as source of information on nuclear-related issues (*ibid.*).

The Swedish case could be described as one of **genuine trust via constructive mistrust**, based on dialogue and counter-expertise, and backed up by strong national-level social and institutional trust, as well as ideological trust in political representation.

3.4 The UK

In contrast with the three forerunner countries, and despite various attempts (most notably in 1982–1987 and 2008–2013), the UK is still to find a willing host for its high-level waste. More often than reactor new-build, waste disposal projects have in the UK been recurrent targets for social mobilisation. Even in the immediate aftermath of Chernobyl, UK residents viewed radioactive waste as a greater risk than a Chernobyl-like accident (Butler *et al.*, 2018).

In 1976, the landmark “Flowers report”¹⁰ by the Royal Commission on Environmental Pollution suggested making nuclear new-build conditional on a solution to the ‘waste problem’. The report also called for the establishment of an RWM planning and siting organisation totally independent from industry (Cotton 2017, 72). Contrasting the latter recommendation, Nirex (the Nuclear Industry Radioactive Waste Executive), set up in 1982 to discuss and develop options, was made up of nuclear industry bodies. From 1987 onwards, Nirex sought to find a willing host for a repository, following a ‘deficit-model’ approach and Decide–Announce–Defend (DAD) tactics. This led to a crisis of trust, which culminated in 1997 when, following a lengthy public inquiry, the government rejected Nirex proposal for an underground Rock Characterisation Facility (RCF) at Sellafield (Cotton, 2017; Butler *et al.*, 2018).

¹⁰ Named after the chairman of the committee in charge of the report, Sir Brian Flowers, a former UKAEA official and a respected nuclear physicist.

The RCF ‘debacle’ provided an opportunity for a fresh start and a ‘participatory turn’: a new independent advisory body, the Commission on Radioactive Waste Management (CoR-WM), was vested with the task of inspiring public trust in the country’s RWM policy (MacKerron and Berkhout 2009). It embarked in 2003–2006 on an unprecedented process of public and stakeholder engagement.¹¹ CoRWM was widely commended for its ability to build trust, via its plural composition, openness to public inputs and analytical-deliberative approach (e.g., Chilvers 2007; Chilvers and Burgess 2008; MacKerron and Berkhout 2009; Morton *et al.*, 2009). None of the organisations involved or observing the process contested the final report’s recommendations (Cotton 2017, 198): in light of current knowledge, geological disposal was preferred, but should be supported by a robust programme of research on interim storage, while volunteerism and broad participation should characterise the site selection (CoRWM 2006).

A Eurobarometer (2008, 40–41) survey on NWM revealed that only 8% of UK citizens would be prepared to leave decisions on RWM to government alone – the lowest figure in Europe, and well below the 21% in Finland and Sweden and 17% in France. The recent and positive CoRWM experience may in part explain this demand for direct participation in decision-making. An earlier Ipsos Mori poll from 2002 illustrated the mistrust of the government: only 22% of the citizens trusted in government’s competence in dealing with the NWM, while 51% thought it was excessively influenced by the industry on this matter (Bickerstaff *et al.* 2008, 157). As many as 75% trusted the environmental NGOs to tell the truth about NWM, while only 30% trusted the industry and 35% the government (*ibid.*).

A multistakeholder West Cumbria Managing Radioactive Waste Safely Partnership (2010–2013) put the volunteering approach to test. In January 2013, Cumbria County Council withdrew from the stepwise siting process. The lower-tier Borough Councils (Allerdale and Copeland) were willing to continue, but since an agreement from all three parties was

¹¹ CoRWM engaged over 5000 people in 8 discussion groups, 4 citizens’ panels, an open access online discussion guide, a schools’ project, a national stakeholder forum, stakeholder roundtables at 14 nuclear sites, open meetings, consultation documents and correspondence by letter or email (CoRWM, 2006, 6).

required, the siting process stalled. Subsequent amendments to the policy, notably the introduction of the notion of ‘Nationally Significant Infrastructure Projects’, seem to transfer power from local councils back towards the central government (Butler *et al.*, 2018).¹²

The UK case could be described as one of ‘ambiguous mistrust’ characterised by growing institutional mistrust of the ‘Big Six’ energy companies (HOL 2013) long-standing ideological trust in market-based energy policy (Rutledge & Wright 2010; Kern *et al.*, 2014) and in “community” (Hildreth, 2011). It further underscores the heterogeneity of publics and ambiguities amongst the UK citizens torn between trust and mistrust towards government scientists and the deficit model (Cotton 2012).

4. DISCUSSION: HISTORICAL LEGACIES, INTERACTION OF DIMENSIONS OF TRUST, AND VIRTUES OF MISTRUST

This section discusses the above-described country-specific descriptions in view of the three arguments outlined in the introduction. First, I will first discuss the ways in which the country- and project-specific historical legacies have shaped trust and mistrust relations, and then move on to illustrating the interaction between the three dimensions of trust and mistrust. Finally, the third subsection draws examples from the four cases to highlight the virtues of mistrust in the form of ‘civic vigilance’.

4.1 Historical legacies: positive and negative

The British and French experiences highlight the importance of negative historical experiences that have undermined trust-building efforts. In the UK, these start from the mistrust generated over the years by the mediocre technical, safety and economic track record of the domestic nuclear industry (Bickerstaff *et al.*, 2008; Butler *et al.*, 2018). Bickerstaff *et al.* (2008, 153) evoke the “rich cultural repertoire of images associated with the history of nuclear technology (pri-

marily in the UK), centering on errors and concerns about institutional control, secrecy and competence”. Ultimately, such images would be rooted in memories and collective consciousness dating as far as the early 1900s (Bickerstaff *et al.*, 2008).

In the planned repository area, Cumbria, the nearby Sellafield nuclear complex has over the years been subject to repeated health and environmental scandals, ever since the fire in 1957 at Windscale (Blowers 2016; Butler *et al.*, 2018).¹³ Mistrust and local opposition were spurred by the Decide-Announce-Decide tactics of Nirex, which sought to educate the presumably ignorant public and persuade it to accept the solution designed by experts, labelling opposition as mere NIMBY-ism and stemming from lack of understanding (Bickerstaff *et al.*, 2008; Butler *et al.*, 2018). The historically established mistrust towards the government RWM efforts also undermined the operation of the West Cumbria Partnership, pushing discussions to broader topics such as nuclear new-build, the types and scale of wastes being produced, and alternative waste management options (Cotton 2017, 212). In the 1990s, scandals such as the BSE (mad cow disease) eroded trust in government’s ability to control scientific and technological risks, and also affected NWM trust-building efforts, as people felt excluded from scientific and technical decisions significantly affecting their lives (Bickerstaff *et al.* 2008, 151).

In the French host region, mistrust has become entrenched throughout the long and conflict-ridden history of the RWM policy, exemplified by local discourses of “us” against “them” (“the state”), and critique against the state’s failure to deliver on its promises. Both opponents and defenders of the project often describe the legally mandatory community benefit schemes as a form of bribery (e.g. Blowers 2016; Lehtonen & Kojo 2019), but which has failed to generate the promised territorial development. Furthermore, while the Meuse and Haute-Marne departments indeed volunteered in the mid-1990s to host a URL, Bure then turned from a host for an URL to a repository host, “almost by stealth” (Blowers 2016), which generated discontent amongst the locals, in the face of overwhelming state power. “We’ve been conned”, a local mayor lamented. The so-called “Cherno-

12 The White Paper stated that ministers would prefer to work with public support, but reserved the right to take more aggressive action on planning if “at some point in the future such an approach does not look likely to work” (Cotton 2017, 229).

13 In 1981, the government renamed the Windscale site as Sellafield, to improve its reputation.

by cloud affair” was probably the most fundamental event generating national-level mistrust towards the country’s “nuclear establishment”: there is a widespread perception that the authorities intentionally sought to conceal the true impacts of the accident in France (e.g. Lehtonen, 2018). In both France and the UK, the tradition of secrecy, traceable to the link between the civilian and military applications of nuclear, constitute another source of mistrust.

In Finland and Sweden, feelings of “broken promises” seemed absent¹⁴, and the industry and authorities underline the importance of patient and perseverant long-term work towards implementation, following prescribed steps and timetable (e.g. Vira 2006; Elam and Sundqvist 2011). In Finland, trust-building has further benefited from the absence of reactor accidents and from the excellent performance of the country’s operating reactors.¹⁵ The Chernobyl disaster probably further enhanced trust in the Finnish solution, by accentuating the prevailing perceptions of a sharp contrast between the ‘safe and reliable’ Finnish technology management and the unreliable and reckless Soviet/Russian ones (Litmanen and Kojo 2011, 181). In Sweden, the 1980 referendum decision to phase out nuclear has enhanced trust and facilitated discussion on waste management.

4.2 Interacting dimensions of trust and mistrust

Institutional trust and particularised social trust

The trust-based and cooperative regulatory style in Finland and Sweden is ultimately based on the strong particularised social trust amongst RWM policy actors. The experts have since their university years built up the kind of close ties that have helped to enhance cohesion and mutual trust across institutional boundaries (Jasper 1990; Montin 2015). In international arenas, the seemingly strong trust that the safety regulator expresses in relation to the operators

often raises eyebrows.¹⁶ While regulation in the UK has a more adversarial and mistrust-based style (e.g. Jasper 1990, 72), in France, the early regulatory style, characterised by trust-based collaboration within an inner circle of experts – notably the regulator and the operators – has adopted international best practices and evolved towards greater transparency, independence of the regulator and openness towards civil society (Foasso 2012; Mangeon and Pallez 2017; Pallez 2019). This hybrid system coexists alongside adversarial relations between the state and the civil society. Unlike in the Nordic countries, the cohesion within the “nucleocracy” or nuclear “establishment” decried by critics has undermined public trust in NWM. Amongst the local population in the host region, it has fed “us vs. them” perceptions and mistrust of the state. As such, it illustrates the downsides of “bonding social capital”.

The UK example highlights the reciprocity and self-reinforcing nature of trust and mistrust. Nirex may have been sincere in its efforts to build trust, yet the Decide-Announce-Defend approach was inherently built on mistrust towards the competence but also the sincerity of citizens. This perception that Nirex and government engineers and scientists were arrogant and mistrustful towards citizens generated resentment, opposition and further mistrust amongst the local population (UK SCR).

Institutional trust and ideological trust

The historical legacies and social-institutional trust/mistrust relations operate against the background of long-standing ideological trust. Ultimately, our cases reflect the historical differences between the Nordic trust-based and the liberal mistrust-based models of democracy, and between the trust-based and mistrust-based regulatory styles (e.g. Jasper 1990; Montin 2015).

In the ‘Nordic model’, the public interest is collaboratively defined and defended by state bureaucracy and local authorities (e.g. Puustinen *et al.* 2017). The Finnish high levels of trust in RWM institutions is backed up by strong ideologi-

14 Despite a promise by TVO in 1980 that the “waste would not stay in Eurajoki” – a promise that local opponents reminded about, but absent from the collective memory.

15 Measured by performance indicators such as Lifetime Energy Availability Factor, Lifetime Unit Capability Factor, and Lifetime Unplanned Capability Loss Factor, the Finnish reactors consistently rank as among the best in the world (e.g. IAEA 2017).

16 E.g. at an RWM conference on 11 April 2019 in Paris, the Finnish regulator was criticised for setting a bad example, as a representative of a forerunner country, for other countries in their RWM management efforts, by founding its activities on an unwarranted trust in the operator.

cal trust in representative democracy, municipal autonomy, state bureaucracy, and legalism (*ibid.*). In such a context, anchoring the approval in a parliamentary decision was vital for the legitimacy of the project. The strong trust in technology and science, rationality, and pragmatism have led some to portray Finland as an “engineering nation”¹⁷, with the ‘Finnish engineer’ sometimes seen as almost a mythical figure (Lammi, 2009). The successful “Finlandisation” of Russian reactor technology in Loviisa further buttressed this perception (Michelsen and Harjula 2017). The Swedish case exhibits similarly solid ideological trust in state institutions, yet the primary object of trust is the system of political representation democracy, while “trust in bureaucracy” appears strong yet secondary (e.g. Kettunen, 2012, 78; Tahvilzadeh, 2015).

The French and British cases illustrate the ambiguities and contradictions in the interaction between institutional and ideological trust and mistrust. In the UK, these reflect the ambiguous relationships between a growing institutional mistrust of the ‘Big Six’ energy companies (HOL 2013), government’s RWM policy (Bickerstaff *et al.*, 2008; Eurobarometer, 2008), and the long-standing ideological trust in both market-based energy policy solutions (Rutledge & Wright 2010; Kern *et al.*, 2014) and “community”, e.g. in the form of “localism” (Hildreth, 2011), such as community energy. Despite the trust in the markets, as a private-industry-led organisation, Nirex was not seen as a legitimate and credible defender of safety and public interest, but instead engendered mistrust and ‘uninvited’ forms of participation (e.g. Cotton 2017; Butler *et al.*, 2018).

The French example, in turn, reveals ambiguities between strong ideological trust in the state as the only legitimate defender of public interest (e.g. Saurugger 2007), and an equally strong and reciprocal institutional mistrust between the state, the local level actors, and civil society. Local actors mistrust the state institutions (esp. Andra) precisely because these have in the past failed to respect the norms of French republicanism and live up to the high standards expected from them. Arguably, the strong ideological trust in the state has ‘raised the bar’, and thereby accentuated the mistrust felt when state authorities are seen to fail to

deliver their promises. Furthermore, local authorities in Finland and Sweden have an established and legitimate role in defending the public interest, while state actors in France and the UK typically mistrust the local authorities. Such mistrust is partly institutionalised in legislation, as exemplified by the recent planning legislation reforms in the UK that shift decision-making power back to the central level.

4.3 Virtues of mistrust, downsides of “overtrust”

In France, the traditionally adversarial relations between the grassroots and the state constitute a fruitful basis for mistrustful and potentially constructive counter-expertise. Given its origins as an offspring of atomic weapons industry, the French nuclear energy sector suffers from a reputation of secrecy and opacity. The state has over the years pushed for transparency, under pressure from civil society, and following especially the controversy over the impacts of the Chernobyl accident (Lehtonen 2018, 63–75). As an enduring topic in nuclear-sector debates in France, transparency has been increasingly institutionalised in legislative acts, multistakeholder bodies, and ‘counter-expertise’ organisations recognised by the state (e.g. Lehtonen, 2018).

However, the Nordic cases provide the most interesting illustrations of the potential virtues and ambiguities of mistrustful ‘civic vigilance’. “Civic vigilance” seems absent in Finland – another indication of the absence of a ‘Nordic model’ (cf. Litmanen *et al.*, 2017). Civic vigilance is founded in the idea that the key function of counter-expertise and NGO activity is feeding mistrust, in the name of the public interest. In Sweden, the two host municipalities adopted a highly proactive role, seeking to build independent competence also in safety matters (Kari *et al.*, 2019). Stakeholder dialogues were anchored at the municipal level political representation, yet they also illustrated active efforts by the state to build trust by supporting municipalities and NGOs in their ‘counter-expertise’, communication, participatory review and monitoring (*ibid.*). The dialogical Environmental Court hearings in 2017, and the attempts by the National Council on Nuclear Waste to provide a more level playing field for debates further helped to build trust. The two-track licencing may have complicated the process yet it also gave environmental NGOs a stronger and specific role in the EIA, and put on a more equal footing and confronted the competing paradigms of ‘planning’ and ‘precaution’ (Keskitalo *et al.*, 2009). Trust was built via long processes

¹⁷ An expression used by an interviewed energy industry representative, in June 2016.

of dialogue, counter-expertise and open exploration of potential weaknesses of the technical solution, that is, via a dynamic interaction between trust and mistrust.

The Finnish example, in turn, reveals great deference to authorities, the rule of law, and the engineers in charge of the project, and relatively strong mistrust of environmental NGOs (e.g. Litmanen *et al.*, 2017). A certain mistrust of civil society is institutionalised within the decision-making structures: administrative decisions alone suffice for construction and operation licences, while funding to NGOs and a counter-expertise tradition are practically absent. The absence of civic vigilance evokes the danger of institutional “overtake” – excessive deference to authorities. The Finnish host municipality seems to have nearly symbiotic relationship with the companies essential for its prosperity, and is willing to fully delegate risk-related analysis to the safety authority (Kari *et al.*, 2019). The shortcomings of the EIA in building trust (Rosenberg, 2007; Strauss, 2010; Hokkanen, 2008) did little to undermine this trust and silent acquiescence in the face of a project that the community saw as indispensable for its socioeconomic wellbeing and survival.

As the recent controversies over the safety of the Swedish repository concept show, the Swedish model carries traits of a mistrust-based regulatory style – which is arguably making inroads to Nordic administration more broadly (Montin, 2015; Puustinen *et al.*, 2017), but does not seem to have yet affected the Finnish RWM policy. The compatibility of the civic vigilance model with the trust-based Swedish tradition remains to be proven. Furthermore, in both Nordic countries, the strong ideological trust in bureaucracy and political representation translates into the corresponding mistrust of approaches that would give citizens a more direct role in decision-making (e.g. Rask 2003; Lehtonen and De Carlo, 2019). In this context of strong institutional and ideological trust, more direct forms of citizen engagement appear as doubtful to many.

5. CONCLUSION

Building trust in the relevant institutions is crucial for the success of nuclear waste management megaprojects and, arguably, for megaprojects more generally. However, efforts to build such trust need to carefully consider three

key elements highlighted in this paper. First, the historical evolution of trust-mistrust relations may either facilitate (like in Finland and Sweden) or hinder (France and the UK) the success of specific trust-building efforts. Experience from research and practice on stakeholder engagement has time and again demonstrated the crucial role of context and history for trust-building efforts. Given the extremely long timescales involved, nuclear waste repository projects help to underline the enduring importance of such contextual factors. Project stakeholder management may well have moved on beyond its initial and arguably excessive focus on a given project by paying greater attention to stakeholder networks (Eskerod *et al.* 2015) and adopting various network approaches to project governance, with trust as a major element in such governance (e.g. Girmscheid and Brockmann 2010) yet the enduring importance of history and context deserves greater attention.

Second, institutional trust is constructed or undermined in dynamic interaction with social and ideological trust. In NWM projects, ideological trust takes on particular importance, given the value-laden nature of nuclear power, and the pervasive role of the state in this industry and markets. However, the relevance of ideology is not limited to the contentious nuclear-sector megaprojects. Quite the contrary, social mobilisation against megaprojects typically stems from disagreement over deeply held values, whether those values concern relations to nature and natural resources, community identities, trust in the state and the markets, or diverging conceptions of justice, democracy and community participation. Analysing megaprojects through the angle of the interacting dimensions of trust and mistrust can help project managers and stakeholders better understand such conflicts and achieve more informed albeit not necessarily conflict-free mutual interaction.

Third, along with efforts to build trust, success in governing megaprojects such as nuclear waste project repositories requires attention to the ways of mobilising mistrust for constructive purposes. Not only is mistrust unavoidable, but it is also an essential element of democracy, which can strengthen megaprojects, including their underlying knowledge base, anchoring in the local community, and democratic legitimacy. Obviously, entrenched mistrust can be highly dysfunctional, and trust and mistrust often go hand in hand. The challenge for megaproject management

is therefore identifying ways in which such interaction between trust and mistrust can serve productive purposes and when mistrust instead becomes dysfunctional. This in turn

requires keen attention to the historically shaped context, and to the interplay between the various dimensions of trust and mistrust.

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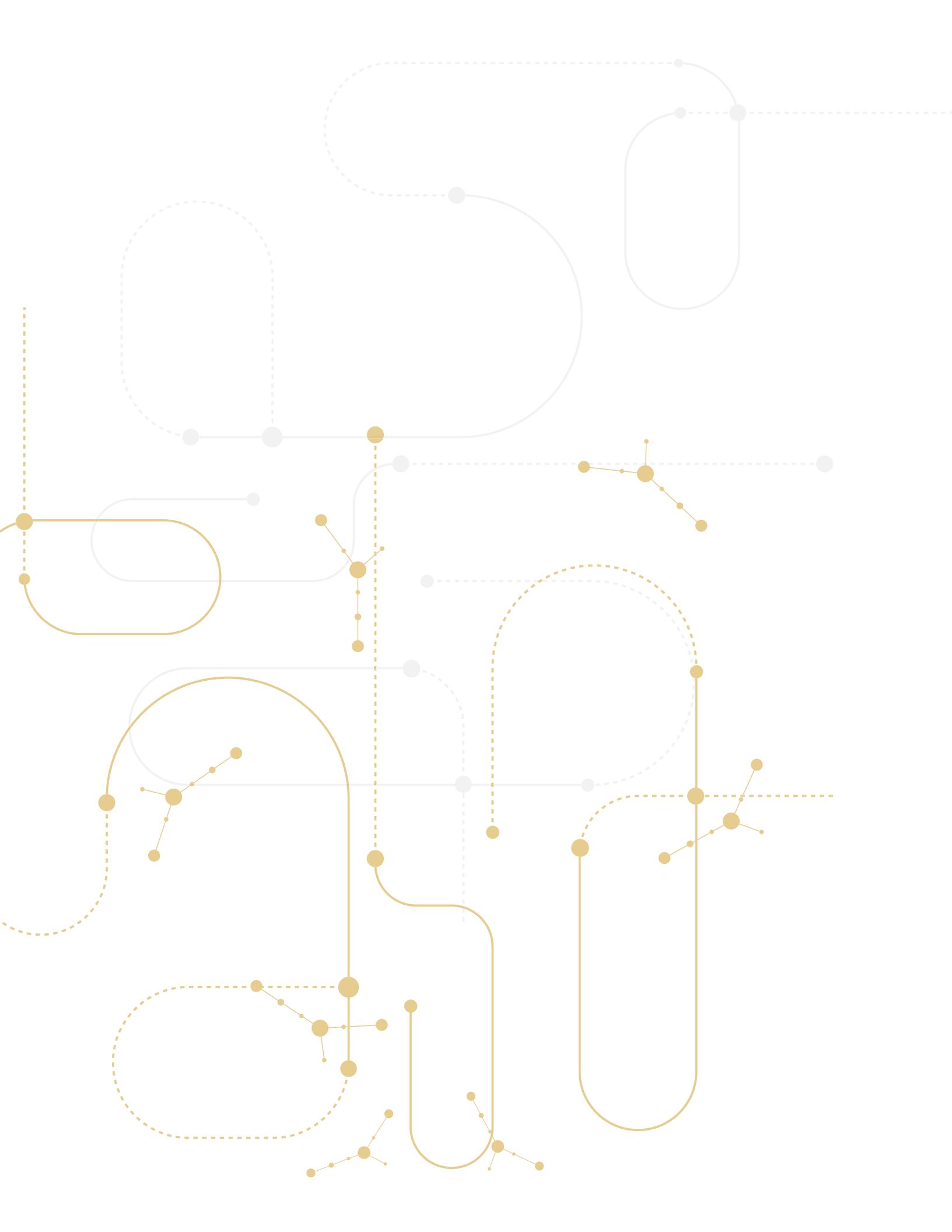
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Symbolism, Trust and Governance in Major Projects

ABSTRACT

We aim to disentangle the concept of project symbolism in order to advance our understanding of the various conditions, processes and effects through which it affects stakeholders' trust in the sponsors of a major project and in the governance arrangements set forth for the project. The main contribution of the paper consists of theorizing two dimensions of the processes involved in project symbolism production. The first dimension refers to the expressive vehicle employed to convey an impression upon social actors. The second one addresses the mechanism through which actors process this impression. Based on the distinctions established by these two dimensions, we propose four types of symbolism and discuss their nature, underlying mechanisms, favoring conditions and consequences in terms of building trust with respect to project sponsors and governance.

Keywords: Project; Symbolism; Trust; Governance; Legitimacy

1. INTRODUCTION

This article proposes a theoretical investigation into the nature of project symbolism that aims to elucidate its role in organizing and governance processes, particularly through shaping organizational identities and perceptions of legitimacy and social responsibility. Major projects serve a variety of instrumental goals, from delivering infrastructures, goods and services that address concrete needs, to providing stimuli for economic development and social change in surrounding areas. But, owing to their size, shape, complexity and impact on people's imagination, such pro-

jects often come to be seen as a manifesto of their initiators' ideology, importance, abilities and power (Lehrer and Laidley, 2008; Orueta and Fainstein, 2008). We argue that a focus on project symbolism can reveal new ways of inducing trust and collaborative behaviors. Typical explanations of such behaviors focus on explicit, deliberately designed governance capabilities, backed by resource and structural asymmetries, and overlook implicit, less coercive sources of governing power, such as those that harness project symbolism to build trust and voluntary cooperation (Lopez Rego, Irigaray and Chaves, 2017; Sanderson 2012). For instance, the symbolic potency of a major project can be a key ingredient in forging a covenant with project participants, which have to bear the risks stemming from the excessive levels of complexity, uncertainty and novelty in such projects; as well as with communities and populations, which have to cope with the inordinate and often unevenly distributed burden of project impacts. Beyond procedural conformity, risk mitigation, communication, and other practices openly aiming to boost social acceptability, project symbolism can induce stakeholders to trust project sponsors, their goals, and their ability to provide diligent, effective and fair governance (Van Marrewijk, 2017).

But what is project symbolism how does it influence participants and stakeholders? What are the implicit or explicit processes at work? We started our investigation with prior research on major project symbolism, which sees it as a deliberate means for expressing the might and superiority of a country or social system, over another (Launius, 2012; Steinberg, 1987); for boosting the status of organizations, cities, countries of leaders that create them (Acuto, 2010), or for conveying their sponsors' values, aspirations and new identities (Van Der Westhuizen, 2007; Ostapenko, 2010; Al-

ekseyeva, 2014). Salient examples of this kind of symbolism include iconic projects, such as Eiffel Tower, Sagrada Familia and Sydney Opera House, which, over time, became recognizable, ubiquitously reproduced emblems of cities or even countries, sometimes well beyond creators' expectations (Acharya and Rahman, 2016).

These feats led to a flurry of copycats, such as the Elbphilharmonie in Hamburg, presented from the outset as deliberate attempts to create a similar 'brand' recognition and attraction effect, and to bring their host city in the privileged category of global cities in a globalized world (Fiedler and Schuster, 2016). While some of them, such as the Guggenheim Museum Bilbao, quickly achieved comparable results, others are still longing for fame. The fact that neither size nor creators' fame guarantees success, suggests that symbolism depends on more complex processes, involving individual perception and cognition as well as social mechanisms and contexts that shape these perceptions. This led us to view symbolism as resulting from autonomous processes that are not necessarily amenable to direct manipulation. In fact, attempts at manipulation may have unintended, even opposite effects.

A second source of inspiration was a study of knowledge representations in innovation projects. The cognitive and social benefits they provide to participants depend on the nature of representations. The concrete, rather than abstract ones are more helpful for problem solving, and coordinating between participants (Florice, Michela and George, 2011). These findings alerted us to the role of what we call the expressive vehicle in project symbolism. Among others, it suggests that symbolism construction processes involve not only final artefacts, such as buildings, but also a long series of project representations, starting with sketches, drawings, mock-ups, maps, plans and reports, and ending with functional prototypes. Such depictions, and related designations and manipulations of meaning, have a crucial impact on forging or damaging trust, because materialized artifact forms do not yet exist. Thus, in many projects, contestation does not start before a concrete representation, such as an architectural mock-up or a detailed map of its pathway, is first produced. To grasp the impact of such wider range of objects and depictions, we sought inspiration in actor-network theory and related streams of research, such as symbolic interactionism and socio-materiality, which see the construction, sharing, and manipulation of representa-

tions as key ingredients in creating the conditions, such as perceptual and emotional stimuli, interpretive premises and material forces, that enable projects initiators to connect and retain actors in a project network, and to motivate them to act in certain ways (Law and Callon, 1988; Pels et al., 2002; Orlowski, 2007).

Another study inspired us to focus on the fact that consequences in terms of attitudes and actions, such as gathering support for a new project idea, result from a mix of emotional reactions and rational reasoning. Large projects need the backing of many stakeholders, from investors to local communities and the general public. Florice et al. (2013) found that when rational arguments are not enough to justify massive scale, impact or effort, or to speed up approval and execution, sponsors use emotional arguments to influence concerned actors. While reliance on such arguments helps achieve immediate goals, in the long term, it impacts negatively project performance. This suggested to us the processing emphasis dimension of project symbolism, which captures the fact that representations exert their influence through a range of cognitive and social mechanisms, some of which persuade by encouraging cold judgment while, others rely on reactions similar to those used by designers and marketers to stimulate impulsive or "conceptual" (lifestyle or ego-expression) purchases. To develop our theorizing of this dimension, we sought added inspiration in cognition research, as applied to design and marketing, on how representations or material forms evoke rational or emotional responses (Buchanan, 1985; Rindova et al., 2011; Verganti, 2003).

In sum, the key contribution of our paper is investigating the theoretical microfoundations (Felin, Foss, & Ployhart, 2015) of the way project-related objects and representation influence symbolism construction processes. In essence, we distinguish the processes through which representation properties, such as concrete forms and associated abstract signs, exert an impression upon actors, from the cognitive or emotional processing through which this impression is transformed into beliefs, attitudes and action propensities, most notably in trust with regard to project sponsors and governance. This distinction allows us to set apart four types of project symbolism and to develop a series of propositions with regards to their respective impact on trust and collaborative attitudes in projects. Our theorizing can, in turn, contribute to answer Van Marrewijk and Smits's (2016: 542)

call to study major projects “as living worlds with their own subcultures, history, rituals, symbols, and practices,” and their invitation researchers to investigate the role of culture, sensemaking and power relationships.

The paper proceeds as follows. The next section includes a brief review of the key literatures that inspired our theorizing. In section 3, we develop the distinction between processes through which representations impress social actors and processes through which these impressions are transformed into attitudes and propensities for action. In section 4, we outline the four categories of symbolism and develop propositions with respect to their impact on trust and collaboration in projects. A discussion and conclusions section outlines the main contributions to project management research as well as to other literatures.

2. THEORETICAL BACKGROUND

Our theoretical development drew upon various streams of organization research that set forth different perspectives for understanding symbolism and the role of representations. For example, observable artifacts are included among the key expressions of organisational culture and identity (Cornelissen, Haslam, & Balmer 2007). Theorists relying on a cognitive point of view see artifacts as “palpable but hard to decipher accurately” (Schein, 1990: 111) if one does not understand the assumptions of the culture that produced them. But researchers inspired by the philosophy of art argue that artifacts “draw stakeholders to them by emotional contagion or by their aesthetic appeal” (Hatch & Schultz, 2002:1002). In the case of this rather direct impact, culture or identity becomes the basis for “identifying symbolic material that can be used to impress others in order to awaken their sympathy by stimulating their awareness, attracting their attention and interest, and encouraging their involvement and support (*ibid.*)”. The signification or the attraction power of artifacts is used for sensegiving or conveying visions of organizational transformation, or, in the case of projects, of social and cultural transformation (Cappetta & Gioia 2006).

In turn, scholars adhering to practice or sociomateriality views, and to activity theory or actor-network theory highlight the role of objects such as projects and their representations in organizing human activities. To paraphrase

Latour (1990) an artifact such as a project is “society made durable”. For example, projects create physical spaces for social interactions but also give rise to contradictions between their aesthetic, sensegiving, and activity- or flow-structuring requirements (Bourdieu 1989; Elsbach & Pratt 2007; Vilnai-Yavetz, Rafaeli, & Yaacov, 2005). Thus, various public buildings, from amphitheaters and circuses in the antiquity to modern theaters, which even today include Royal loges, or from execution podiums in public places to nobility- or donor-reserved seats in cathedrals, were structured in ways that differentiate the members of the public, but also allow all of them to watch displays of power, from lavish attire and elaborate ceremonies to cruel executions (Foucault 1975; Mathiesen, 1997). At the same time, with the growth of security concerns, the design of buildings and public spaces emphasize not only their direct functional purposes but also such aims as access restriction, security screening, anti-ramming protection, crowd control, evacuation speed, or crime prevention (Schneider & Kitchen 2007).

Socio-materiality research pays a particular attention to the material characteristics, or the affordances (Gibson 1982), of the external supports of such representations, for example of functional prototypes, clay mock-ups, drawings on paper, or imagery on computer screens, as a force that shapes the social tissue surrounding projects (Latour 2005; Barad 2007). In particular, actor-network theory characterizes representations as actors in their own right, which, once produced, exert a non-trivial influence on other actors. In a project context, these streams emphasize representations as epistemic and boundary objects. Preliminary project representations, from sketches and crude models are seen as tools for understanding client needs and stakeholder apprehensions, and to negotiate functional and social requirements with them (Yoo, Boland & Lyytinen 2006). They also play a significant role in allowing the integration, coordination, and separation of the various actors involved in the design process (Bechky 2003; Carlile 2002; Ewenstein & White 2009).

In turn, neo-institutional and political literatures emphasize the ways in which projects and their representations symbolize social movements or convey new rational myths. In this case, the meaning is not intrinsic to the form but it is bestowed upon it through rhetoric and communication efforts. For example, the Rogun Dam in Tajikistan has been depicted as the cornerstone of building a modern and in-

dependent nation in a post-soviet republic (Menga 2015). More broadly, the linguistic turn in social sciences (Alvesson & Kärreman 2000; Deetz 2003) has brought to the fore the role of words as tools for social action, for example through their capacity to evoke the right emotions, or their role in legitimating processes that associate action with alternate narratives, such as effectiveness versus justice (Suddaby & Greenwood 2005). In turn, research on promotional messages, brands and industrial design, have highlighted the semantics of forms and the way objects such as objects evoke various archetypes of form and convey meaning and stimulate emotions (Verganti 2003).

These review hints at a variety of processes shaping the perception of representations as well as their influence on action. Thus suggests that symbolism itself has different meanings and effects, which we attempt to disentangle in the following sections.

3. PROCESSES INVOLVED IN PROJECT SYMBOLISM

To symbolize means to stand for something else. The most common use of the word "symbol" is a letter or other graphic sign that stands for a concept, the way "V" stands for a measure of electric charge (one volt) or for the idea of "victory", frequently when the letter is expressed with one's fingers. But places and artifacts also symbolize something, for example the victory over an enemy, often in a metaphoric way. Proponents of the artistic current named 'Symbolism' explicitly advocated the use of shapes, colors and textures, rather than symbols, to refer the observer to 'otherworldly' ideas and significations. Artists applied these ideas by moving away from the concrete details of surrounding reality, emphasized by the artistic currents of naturalism or realism, or from their fleeting, immediate perception, emphasized by impressionists. In many ways, Symbolism was a return to romanticism, or even further back, to medieval and early Renaissance art, in which the various characters depicted on a canvass, their looks and relative positions, as well as surrounding objects and landscape, evoked abstract religious or other esoteric concepts. While still relying on human and natural forms, although often omitting or deforming their concrete details, they evoked something beyond perceptual reality. An obvious example are icons: pictorial representations of saints, particularly widespread

in Orthodox Christian churches, which use rigid canons of representing faces, forms, light and perspective to symbolize spiritual aspirations (Antonova 2010; Florensky 2006; Sendler 1988). In the early twentieth century, proponents of 'abstract' art went one step further and abandoned altogether the depiction of human and natural forms as a vehicle for expressing ideas. Kandinsky, the pioneer of abstract art, suggested that artists can express as effectively their ideas by relying on a language of abstract forms, orientations and colors. Not surprisingly, *Composition VII*, one of Kandinsky's most well-known abstract paintings represents the Final Judgment. Yet, like grasping the profound sense of medieval art, which has been lost to modern viewers from secular societies, understanding contemporary abstract art often requires expert guidance.

This brief excursion in the history of art and symbolism serves to introduce a distinction regarding the expressive vehicles that are employed in relation to projects, namely between letting concrete elements express themselves and establishing symbolic connections to abstract meanings. A similar distinction can be seen in the work of designers and marketers. Some of them emphasize the immediate beauty of an object and the emotions it triggers directly, like Classic or Impressionistic art, or its direct functional "message," like the art of social, moralist or socialist realism. Yet a recent tendency has been to emphasize the symbolic meaning of an object. For example, Atwal and Williams (2009: 240) argue that "consumers use consumption to make statements about themselves, to create identities and to develop a sense of belonging [and] goods are acquired for what they symbolise." Designers stress that the design (form) of objects has a signification that can be used to communicate and to persuade, beyond functional characteristics (Buchanan 1985; Verganti 2003).

This search for the essence and means of visual arts suggest a range of means for influencing social actors, which inspired a first dimension of processes involved in major project symbolism. When exerting influence on actors, projects speak either by themselves, through their material, projected or reproduced form, or by relying on some sort of symbolic language. This first dimension, which we call *expressive vehicle*, distinguishes whether actors are stimulated by project-related representations and objects, on the one hand, through the immediate perception of their *concrete* form, texture and behavior, or, on the other hand,

through their association to a network of *abstract* categories and significations (Florice, Michela and George 2011). At the concrete end of this dimension, actors are more aware of the peculiarities of focal objects. In this case, the symbolism of projects comes from their novel, special or puzzling nature, which makes related objects and representations more ‘opaque’ (Dreyfus, 1991), meaning ‘visible,’ for observers or users. At the abstract end, project symbolism comes from the way actors’ perception of focal objects is predetermined by associated categories in their brains (Zeki, 1992), whose meaning is itself derived from a network of related symbols and significations. Objects themselves are more ‘transparent’ (Dreyfus, 1991); audiences already perceive them as a symbol of some concept, without resting on concrete details. This occurs when their creators find a way to induce observers to ‘recognize’ or to believe that relevant objects are an instance of a generic category.

Paradoxically, it is the abstract end of the dimension which is currently emphasized by project management literature (Hekkala, Stein and Rossi, 2016; Seidel, and O’Mahony, 2014) as well as by management disciplines in general (Dutton and Jackson, 1987; Gioia & Chittipeddi, 1991; Lounsbury & Glynn, 2001), in line with the “cognitive” and “linguistic” turn in social sciences. But, in their discussion of the expressive role of the elements of social assemblages, Deleuze and Guattari (1987) distinguish between components “which are directly expressive, and those which rely on a specialized vehicle for expression, such as human language,” and decry the fact that “many aspects of both experience and behavior which are directly expressive [...] are all lumped together under the label ‘symbolic’” (DeLanda 2006: 253). Indeed, project materializations and representations also impress perceivers directly, by means of their size, affordances, complexity, novelty, functionality and beauty. Project developers, as well as tourism, city branding and economic development agencies multiply and distribute concrete images of landmark projects to attract investors, participants, visitors and human resources. Projects ‘symbolize’ themselves by means of the emotions, thoughts and action propensities they raise in users. We now turn to these effects that project materializations and representations have on users in order to discuss the second dimension that will help us understand project symbolism.

Irrespective of whether project actors are led to perceive a configuration of concrete features or to distinguish a

category, they can respond in ways that range from uncontrolled emotional reactions to detailed rational calculations. On the one hand, the concrete form, matter and behavior of project-related objects and representations activate a number of perceptual, emotional and cognitive mechanisms. For example, like any technical system, a major project can be evaluated explicitly or intuitively with regard to its usefulness, functionality, commodity and ergonomics. Like any object, major projects can also trigger emotional reactions, from aesthetic pleasure to dread (Desmet and Hekkert, 2007). Their form may be judged as beautiful or ugly, modern or dated, vulgar or elegant, and cognitive scientists debate whether judgments of beauty, in art or in human faces, are based on a direct emotional reaction or are mediated by elaborate cognitive processing, which implicitly or explicitly compare the object to known or prototypical objects.

On the other hand, abstract categories evoked in relation to project are usually deemed to be the object of “cold” cognitive processing and evaluation. But abstract categories can also trigger strong emotional reactions, even when actors are not in the presence of, or even did not have a chance to directly perceive objects associated with the category in question. Hence, social actors are taught from early childhood to love, hate or fear certain categories of people, actions and objects. Such apprehensions are later in life reinforced by education, mass media and social entourage. Evoking these categories in relation to projects and socially amplifying the associated fears may generate emotional reactions, leading to heated debates, political activism, protests, riots, strikes, revolutions (Covello and Johnson 1987; Luhmann 1993), or diplomatic and military conflicts (Bouzarovski and Konieczny, 2010; Haftendorn, 2000). An example is the Nord Stream 2 project, an underwater pipeline promoted by the energy conglomerate Gazprom, to enable deliveries of Russian gas directly to Germany, through the Baltic Sea. Opponents and media regularly associate the project to dangers such as increasing European dependence on Russian energy, cracking of Euro-Atlantic solidarity and surrendering Ukraine and other Eastern European nations to Russian imperial ambitions.

This range of responses to both concrete and abstract vehicles led us to propose a second dimension, called *processing emphasis*, which distinguishes whether actors’ attitudes and action propensities change, on the one hand, through ‘hot’

emotional or impulsive processes, or, on the other hand, through rather 'cold' judgmental and calculative processes (Floricel, Piperca and Banik 2011). This distinction does not imply a mind-matter dualism, as we admit that all cognition has a biological and material basis, and that emotional processes are essential for effective judgment and decision (Barsalou 2010; Hodgkinson and Healey, 2011; Bechara et al. 1997). It only suggests different processing emphases, perhaps reflected in a different activation of various brain areas. On the *emotional* end, the impression triggers a rather fast reaction, accompanied by strong feelings, with good chances of being followed by spontaneous actions. Through basic survival-related cognitive circuits (Kandel 2006), project representations are processed by our pattern recognition capacities, responsible for setting apart friends from foes, and dangers from desirable stimuli. Recognition triggers strong emotions, which may range from fear to pleasure and desire, and prepared the body for actions such as fighting, fleeing or courtship. This recognition and stimulation process may match the project against some deep seated archetypes imprinted in our brain by genetic or cultural mechanisms, as well as by high-impact personal events, particularly in early life, and may be responsible for its deeply felt acceptance, rejection or strong opinions about its usefulness or beauty. In this case, project symbolism stems from the emotions that come to durably and widely accompany their perception or evocation, as well as from the associated patterns of actions, some of which may be formal ceremonies, either deliberately choreographed or gradually institutionalized through periodic repetition.

On the *cognitive* end, the impression from the project generates slower evaluative and decisional processes which more gradually build commitment towards a particular course of action. We believe that this kind of processing relies in part on mechanisms that support our spatiotemporal orientation abilities, also deeply seated in the ancestral need to find a way towards food and avoid dangerous places. The project, its operation and related trajectories of action may be matched against the isomorphic maps of places and routines that actors hold implicitly in their brains, or be judged in relation with the patterns of connections

between the element of the world, stored in our brain in a form that Sheppard and Chipman (1970) termed 'second order isomorphism' with regard to immediate sensations. This cognitive processing enables actors to evaluate the forms, spatial contexts, material affordances and dynamic behavior of novel and complex projects, especially in relation to their own routines and needs (Bourdieu 1985, Gibson 1982). In addition to these mechanisms based on a rather limited level of abstraction, processing may rely on our innate ability to create, relate and manipulate abstract categories (Schopenhauer 1966). This includes the ability to imagine highly abstract dimensions, including some with no correspondence in the perceived world (Poincaré, 1912), but also to elaborate networks of cultural significations (Geertz, 1973). This ability helps reduce projects to highly abstract indicators such as Net Present Value but also to tie them to abstract social and cultural referents, such as progress, democracy and ethics. In sum, on the cognitive end of the processing dimension, symbolism stems from the network of concepts, as well as of habits and routines to which the project becomes attached or embedded.

Based on expressive vehicle and processing emphasis dimensions, we propose below four categories of symbolism. For each of them we identify the conditions that favor the emergence of the respective kind of symbolism, the dominant cognitive mechanisms involved, and highlight their most likely impact in a the context of major projects.

4. A TYPOLOGY PROJECT SYMBOLISM

The four categories of symbolism that result from intersecting the dimensions discussed above are outlined in Table 1. For each category, we discuss its nature, most likely cognitive mechanisms and its impact in the context of major projects and illustrate it by referring to the New Copenhagen Opera project, completed in 2005, studied based on secondary sources and a guided visit. The discussion for each category concludes with a proposition regarding its most likely impact on the development and execution of a major project.

Table 1. Four categories of project symbolism

Processing emphasis	Expressive vehicle	
	Abstract	Concrete
Cognitive (reflexive; practical; calculative; judgmental)	Conceptual rhetoric Nature: uses category attribution and manipulation to position the project in a broader network of beliefs regarding the relations between social goals and means Mechanisms: abilities to abstract properties of objects and operate logically with generic categories of objects Conditions: institutionalized beliefs of desirable goals and strategies; vocabularies of means-ends arguments Effects: Cognitively legitimates the project by associating it to a workable set of goals, actions and means through sense giving and manipulation, narratives and rhetoric strategies	Functional structuring Nature: uses project form to position the project in the flow of habitual actions of its users and highlight distinctions or similarities in use and functioning Mechanisms: innate abilities to relate objects in space and time, and to assess the affordances and behavior of complex objects Conditions: taken-for-granted action patterns (routines, habits) in a pre-existing technical/built environment Effects: Pragmatically legitimates the project through design strategies that help the intuitive understanding of its functioning, uses and future possibilities
	Visual signification Nature: uses canonic forms to induce associations to a broader network of value categories (modernity, ethics, hedonism etc.); brand imagery, ceremonial memory Mechanisms: schemata-guided perception connected to a deeply-felt sense of self, identity & belonging; desire for self-affirmation, self-expression and self-defense Conditions: institutionalized values and a vocabulary (canons) of artefact form interpretations Effects: Morally legitimates the project as a vehicle for expressing values (modernity, ecology etc.), aspirations or associations, and as a weapon for identity defense	Immediate impression Nature: uses project form to generate aesthetic or amusing pleasure or displeasure; stimulation or aggression, interest or boredom, attraction or rejection Mechanisms: automatic pattern-recognition abilities connected to (subconscious) emotion- and action-triggering mechanisms Conditions: archetypes of friends and foes acquired instinctually (genetic encoding) or in early childhood Effects: Viscerally legitimates the project by making it a focal point of (partly unconscious) desires, envy, greed, passions, fears, insecurities, frustrations and complexes

4.1 Immediate impression

This is a form of symbolism in which the project stands for a multifaceted emotion directly, without pre-set conceptual associations. This category of symbolism uses the concrete form (configuration, texture, color, dynamics etc.) of project materialization or representations to generate emotional reactions, such as aesthetic pleasure or displeasure. It relies primarily on the pattern recognition mechanisms that underpin our instinctual self-protection abilities, which are connected to emotion- and action-triggering mechanisms at a subconscious level. These mechanisms translate the perception of form into favorable or unfavorable attitudes, such as aesthetic appreciation, as well as in a largely implicit attraction or rejection of the project. The emotions and reactions the project produces depend on the attractive shapes and the archetypes of 'friends' and 'foes' that are genetically imprinted in our species or acquired through everyday experience or the outstanding events they witnessed. The implicit nature of the processes and the resulting emotional appreciation blur the reasons why the concrete form strikes a chord and prevent making this form of symbolism more explicit. These obscure origins, as well as the differences between individuals in their everyday experiences and lived events preclude the attempts to identify the source of differences between individuals and groups, as well as to achieve a consensus between various actors' evaluations. This is of particular relevance for project trust and governance, because it can lead to endless debates. Among artistic currents, this form of symbolism would be closer to the aims of antique and modern Classicism, with its search for the perfect beauty, for example through the proportions of human bodies and buildings, as well as of impressionism, with its quest to capture the way a fleeting concrete reality creates emotionally colored perceptions. A similar influence is studied by marketers, who developed psychanalysis-inspired methods, such as Zaltman Metaphor Elicitation Technique (ZMET), to probe consumers' subconscious, using images and analogies to uncover archetypical forms and associated deep desires and fears to which they can 'attach' their product designs and promotional campaigns (Zaltman and Coulter, 1995). More recently, in a rather controversial move, some started relying on imaging equipment that captures neural activity in consumers' brains to assess the potential of product shapes and colors to trigger strong emotional reactions that lead to impetuous reactions known as 'impulsive purchases.' With the rise of

'experience economy' marketers also rely on similar mechanisms by creating a perceptual environment known as 'atmospherics' in retail outlets to induce purchases (Kotler, 1973). In turn, industrial designers are also concerned with the ability of product forms to generate an entire range of emotions in the users of the objects they create (Desmet and Hekkert 2007). Some of them closely collaborate with psychoanalysts to uncover deeply-seated form archetypes and with abstract artists to understand how forms create an aesthetic impact (Rindova, Dalpiaz & Ravasi 2011). Closer to the forms found in megaprojects, architects use building forms to convey their sponsors' significance but also to evoke deep seated archetypes. The dominating order of Stalin's empire is best symbolized by seven high-rise sister edifices built in the 1950s in Moscow (some copies were also built at the same time in other ex-communist countries). The best known hosts the Lomonosov State University. While wanting to express more abstract notions, including progress and a national style that echoes the Kremlin towers, these buildings, particularly the Lomonosov University impress primarily through their size and mass (Beck, 2004). This contrasts with many steel and glass high rise buildings around the world, which convey a sort of dreamlike lightness; buildings reflect and confound with the sky, evoking always unfulfilled aspirations of freedom.

Another example of this type of symbolism include the Sydney opera, whose soaring shell-like structures evoke perhaps the natural environment of the Sydney harbour, but have become a splendid visual symbol in themselves, so unusual and novel that nobody knew whether this kind of form can be built when the project was approved (Bereson 2002). Despite the significant cost overruns and delays, its iconic potential was evident since its inauguration, and local contemporaries recognized that by size, technicity and novelty it is...

not just a thing of stone and glass created by computers. It is a pyramid, a temple, reflecting in its multi-faceted complexity the subconscious will for greater self-expression by our people at this era in our history.
(Cited in Bereson 2002:159)

In time, the building has become the most recognizable visual symbol of its city and country, the seat of many events and ceremonies with global impact, such as the Sydney Olympics (Bereson, 2002; Colbert 2003). It is systematical-

ly reproduced in tourism websites and pamphlets and has become an integral part of the visual branding of Australia. This success spurred imitators around the world, among them the architects of Elbphilharmonie (Elbe Philharmonic Hall) of Hamburg, who put on top of an old warehouse, symbolizing the local grounding of the building, a wave-like structure made of glass, which evokes the historic association with sea of this Hanseatic trading city, globalized *avant l'heure*, but also the deep archetype of a lawful yet always moving world (Balke, Reuber and Wood, 2017).

In terms of effects, the immediate impression kind of symbolism resulting from the materialized objects, such as buildings, dams, aircraft etc., and their representations, such as photos, artistic renditions, mock-ups etc., viscerally legitimates or de-legitimizes the project by making it the focal point of (partly unconscious) desires, greed, passions, envy, fears, insecurities, frustrations and complexes. This kind of symbolism is, first, difficult to achieve, because it is very hard to strike the right chord with the concrete form, which makes the adaptive space searched for such a project resemble a rugged landscape (Levinthal, 1997), perhaps amplified by their continuous depreciating proliferation. Most examples of landmark buildings achieved strong acceptance from the first sketches or early artistic renditions, but eventual misses in appreciation, possible because the ultimate impression is obtained only when actors are confronted to the materialized object, are almost impossible to correct. Second, differences between individuals and groups in terms of experience and resulting deep archetypes may also lead to divergent visceral feelings. In turn, this may cause inter-group differences in terms of legitimacy and trust outcomes, which may be difficult to reconcile because of their deep-seated, emotional nature, less amenable to rational arguments, perhaps seated in various metaphors that can be associated with the project. So, we expect that, for this kind of symbolism, projects will either strike a universal emotional chord or will generate endless debates during project development, execution and, especially, early exploitation.

The Copenhagen Opera House provides an interesting illustration of this kind of problem. The project was designed by the famous Danish architect Henning Larsen but was financed by Maersk McKinney Møller, one of the main shareholders of the logistic company Maersk. As an allusion to maritime activities of Møller's firm, the building evokes the command deck of a ship. But Møller interfered with almost

all aesthetic decisions of the project. Among others, he imposed the use of metal striations on the glass façade of the building which drew associations with the grille of a 1955 Pontiac (Lorentzen, 2005). The public, critics, and eventually the architect himself considered the building to be an aesthetic failure; it has been compared among others with a fly or a spaceship (Grabar 2013). The above arguments lead us to propose the following proposition.

Proposition 1: 'Immediate impression' symbolism has the lowest probability of achieving the corresponding visceral legitimacy but also the highest likelihood of generating irreconcilable differences between project participants; but in case it is established, which may happen quite early during a project, it is more likely to last and inspire participants to trust project sponsors and its governance.

4.2 Visual signification

In this kind of symbolism the project form evokes abstract concepts for which social actors have strong feelings. It relies on what could be termed 'canonic' forms or on their representations to associate the project to general notions such as modernity, ethics or hedonism. These forms embody a message in a visual language, which influences stakeholders' impressions because actors have been exposed to similar forms and are able to recognize them as instantiations of the generic category. The involved perceptual mechanism is schemata-informed perception, in which actors directly see the project in abstract terms, which often involves overlooking contradicting details or 'adding' other details that are really not present (Anderson 1980). We placed this kind of symbolism on the emotional processing end, because evoked schemata speak first and foremost to a deeply felt sense of self, but also of associative identity and desire to belong to a group. The latter 'social' elements, and the promotion and defense of related objects and ceremonial patterns of action, underpin many aspirations for 'individual' self-affirmation and self-expression. These meanings also shift continuously as new objects become part of a given culture. For example, contact with new forms of matter, as primitive people shifted from societies of hunters-gatherers to agriculture and object making, revealed new parallels with their existence, and generated new religious symbols (Eliade 1978). Likewise, the emergence of Internet and related social media generated new forms of life, which, in turn, led to the

emergence of new visual symbols for expressing a modern, 'cool' behavior and prestigious affiliations. But despite this dynamism, the institutionalized values and the vocabulary (canons) of forms upon which depends the interpretation of projects are relatively stable; the main issue is whether project forms are canonic and associate the project to the right values.

In terms of art currents, this type of symbolism and its mechanisms can be related to medieval and early Renaissance art, particularly icon painting, as well as to nineteenth century Romanticism and Symbolism, and a host of more conceptual currents culminating with abstract art, all of which aim to convey meanings beyond the concrete details of their art and seek new means of expression to do so. Marketers also realized that people no longer consume products but concepts. As symbols of their values, products become canonic means for self-expression. For example the kind of food one purchases, the way food is prepared and consumed, become a symbol of a healthy way of life, of consumers' knowledgeability, or even of their stance against the encroachment of industrialization in all areas of life (Ariely and Norton 2009; Moisio, Arnould and Price 2004). In this context, marketers, designers and communicators understood that images, and among them megaproject representations and forms, can be used as a visual language to express sophisticated messages (Oversteegen and Schilperoord 2014). Designers attempt to incorporate elements of symbolic value, in addition to functional benefits and aesthetic appeal, in the form given to products (Van Rompay, Pruyn, and Tieke 2009). Firm and brand logotypes and other canonic visuals are typical additions of this kind, that append a halo of brand-related properties, some quite difficult to assess objectively, to the perceivable details of a product.

But the ability to convey such messages requires an understanding of institutionalized or emerging values, lifestyles and shared vocabularies of artefact interpretations. Designers and marketers associate themselves with anthropologists and ethnographers in order to understand the web of significations that members of relevant subcultures have developed and the visual language that conveys these significations through the objects that constitute their world (Rindova, Dalpiaz & Ravasi 2011). For example, motorcycle maker Harley Davidson commissioned a study of biker subcultures, which, among others, uncovered the significations

of the various modifications that members of these subcultures effect on motorcycle parts and forms and even of various movements and noises which these motorcycles make (Schouten and McAlexander 1995). Likewise, Italian manufacturers of household products, such as Alessi or Artemide, emphasize new significations rather than the aesthetics of their products' designs; their competitive advantage stems from their "capability to understand, anticipate and influence the emergence of new product meanings," (Verganti 2003:38), related to new socio-cultural models or lifestyles.

In terms of effects, this kind of visual symbolism can morally legitimate the project, by associating it with emerging values, such as tolerance or ethical consciousness, as well as with defending the traditional identity and values of societies and nations. Thus, beyond their height and obvious phallic symbolism, which symbolizes the might of project sponsors, variations in the form and texture of various high-rise towers also attempt to convey different cultural associations. The sail-like form of the Burj al Arab hotel in Dubai is an allusion to a dhow, the traditional merchant ships in the region (Steiner 2010). [A similar symbolism was used the W (Vela) hotel in Barcelona.] Likewise, Burj al Khalifa, also in Dubai, the tallest building in the world, evokes, through its size and spectacular architecture, the aspiration to become a world city, but its form also alludes to traditional forms of Islamic architecture typical for its region, such as the Great Mosque of Samarra, Iraq (Acuto, 2010). We already mentioned that the New Copenhagen Opera House, evokes the command bridge of a ship, and through it a long tradition of shipping in Denmark, but also the success of the founder of a maritime logistics multinational, who entirely financed its construction. But the location of the project also has a deep identity symbolism. The building rises on the opposite bank of the Copenhagen's harbor (sea canal) but on the same axis as Frederik's Church, one of the most important religious buildings of Copenhagen, and the Amalienborg complex, the Queen of Denmark's winter palace. By being located on the opposite bank from these historic buildings, amidst warehouses and industrial buildings and close to less affluent neighborhoods, including the famous Freetown Christiania, as well as by adopting a definitely modernistic, almost industrial architecture, reinforced by the addition of metallic elements to the glass façade, in opposition to the more traditional styles of the palace and church, the opera house may not only demonstrate the sponsor's might but also symbolically pit his shipping ancestry and success

against bloodline nobility. This highly symbolic location was adopted at the insistence of Møller but was deemed to be "hubristic" (Grabar 2013). In light of the above discussion we propose the following proposition.

Proposition 2: 'Visual signification' symbolism has higher chances of achieving the corresponding moral legitimacy, provided an adequate effort is dedicated to understanding or developing the required representation canons, but can generate divergent interpretations of the adequacy of represented values and of the project fit with these values, which can persist throughout the project life and affect trust in its sponsors and governance.

4.3 Functional structuring

This category of symbolism relies on the concrete form of the project to designate its position in the flow of habitual actions, for example by highlighting its distinctions or similarities in use and functioning with respect to existing projects, or its interactions with broader technical systems. This symbolism relies on our cognitive abilities to relate objects in space and time and to anticipate intuitively or master through practical interaction the affordances and behavior of complex objects. Most of this assessment is implicit, as actors attempt to navigate and use the project in their habitual ways, skillfully but mostly thoughtlessly, adapting to the peculiarities of its form and functioning (Emirbayer and Mische 1998). But, in some cases, the project configuration and features precludes actors from continuing as usual; they are forced to focus on project particulars, which become 'opaque' rather than 'transparent' as they are in normal use (Dreyfus 1991). Actors engage in a more explicit process of sensemaking or problem solving regarding the project and its use, by relying on their past experience with similar projects and situations (Weick 1993). From this perspective, the symbolism of a project consists of largely implicit assessments of its ease of use or ergonomics, some of which are colored by explicit representations, amplified by media and word-of-mouth, of the encountered problems and difficulties along with the change in routines required to overcome them (Feldman 2000). Hence, despite its superb architecture and relatively uneventful execution, the London Heathrow T5 airport terminal project is known primarily for its launching day disaster with the luggage handling sys-

tem, which forced the diversion of flights to other airports (Davies, Dodgson & Gann 2010).

Sensations of familiarity or unfamiliarity, functionality or dysfunctionality of project form may further stakeholders' trust in the promoters' shrewdness or, on the contrary, repel through the projected ineptness. In addition, this symbolism also highlight the inclusive or exclusive, segregating or integrating nature of the project (Acuto 2010), which more directly affects trust, through perceptions of fairness. Assessments may differ as a function of actors' needs and positions in relation to the project. For example, plans for the Turcot interchange reconstruction project in Montreal were contested on grounds that the intended configuration would place some relatively poor neighborhoods in an enclave, only accessible through a tunnel (Gauthier, Jaeger and Prince, 2009). Another source of problems is that evaluations and debates rely on representations, such as technical drawings or mock-ups, rather than materialized technical objects. While technical experts are used to preparing and using such representations to envision and evaluate the properties and behavior of technical objects in the course of design activities (Ferguson 1977; Floricel, Michela and George 2011) other actors may lack the ability to imagine the spatial and motor consequences following from these representations, and hence be negatively surprised when attempting to use the project. In terms of art currents, this kind of symbolism may be associated to religious moralizing paintings (Aikema 1996) or with the social messages typical of the works of Naturalism or Realism, particularly Socialist Realism, from which the viewer is supposed to understand directly or indirectly the kind of actions and attitudes that lead to favorable consequences.

In terms of effects, this category of symbolism contributes to pragmatically legitimate the project (Suchman 1995). Anticipative representations or the form of resulting artifacts enable stakeholders to intuitively understand the functioning, uses and future possibilities of the project. This kind of legitimacy depends on users' intuitive assessment of their own sensorimotor and cognitive abilities, and their understanding of, or ability to imagine the patterns of action, such as habits, spatial trajectories and interaction routines. It may also be problematic to transfer these assessments and understandings to a new context because abilities and patterns are mostly taken-for-granted, and situated in given temporal context and a pre-existing technical or built

environment. Of course, to solve this problem, marketers and developers of new products and systems have created methods for the detailed study and translation of user needs and requirements (Griffin and Hauser 1993; Goguen and Linde 1993). Ergonomics experts also study users' sensorimotor and cognitive capacities and adapt the forms, colors, lighting and movements of objects accordingly. User observations and product trials enable designers and architects to study use patterns and identify the difficulties, some of them not avowed, which users experience with existing products, systems or prototypes. Virtual and rapid prototyping techniques facilitate the creation of objects that users can try in order to get a better feel of using the final object. In major urban and infrastructure projects, such representations are increasingly used in order to communicate the project to stakeholders and affected parties as well as to enable their input.

Architects and designers also seek to creatively use the shape of objects and their elements to intuitively communicate to users the functional benefits that objects provide them (Crilly, Moultrie & Clarkson, 2004). They also attempt to intuitively 'explain' to them how to use the object, for example, by increasing the size or altering the color of important elements (Monö 1997). Achieving this desideratum of persuasive intelligibility appears to rely on a specific form of rhetoric (Buchanan 1985), which led us to classify the respective mechanisms on the rational end of the dimension that captures the influence on stakeholders' attitudes and actions. Designers of highly innovative products discovered the importance of blending familiar forms, which evoke known products that users understand, with unusual forms, which express the novelty and difference with respect to existing products. The best combinations appear to strike a balance between the attraction of novelty and the security with regard to the usefulness and ability to master the new artifacts (Hargadon and Douglas 2001; Rindova and Petkova 2007).

The case of the New Copenhagen Opera House also serves to illustrate this category of symbolism. While, as explained above, the aesthetic choices made during the project are controversial, facilities are deemed to be quite functional. For example, the size, acoustics, lights, voice-protecting humidifying systems and other features place the opera among the best musical stages of the world. From the point

of view of opera goers, one problem could be the location on the opposite side of the harbor/canal from downtown Copenhagen. Besides, the opera is located on a sort of island formed by canals used for shipping activities. The architects chose to preserve or even extend the canals to reinforce the perception of a special insular location. This location complicates the access to the site, by car or by foot, and may reinforce an impression of segregation for its industrial and lower income neighbors. However, it also creates the premise for an interesting experience for visitors, particularly for tourists, who can arrive from central Copenhagen as well as from other neighborhoods via water buses, which are part of the public transportation system of the city.

This project also illustrates how architects can stealthily shape a key functional structuring aspect of many major projects, namely the structuring of social interactions. Since Greek and Roman times major projects were dedicated for creating agoras, forums or markets. The foyer of the New Copenhagen Opera House was designed to satisfy the contradictory desire of modern opera goers to be able, during entr'actes, to both timidly stay aside and observe other people, as well as to showcase themselves and their fashions. The solution was, on the one hand, creating many places where people could stand along walls and windows, and on the other hand, forcing them to enter the concert hall through a series of bridges with transparent balustrades, which are open to viewing from all directions, almost like a catwalk used in fashion shows. In order to uncover this contradiction and design the configuration that solves it, architects observed the audiences' patterns of behavior in various opera houses around the world. Observation, rather than interviewing, was used because opera goers are unlikely to be aware and willing to talk about the contradiction, and it is also likely that their satisfaction will remain implicit. Unless architects' thinking is explained to them, visitors will find that the opera is, for obscure reasons, just a place where they feel at ease. This discussion enables us to propose the following proposition:

Proposition 3: 'Functional structuring' symbolism has good chances of attaining the corresponding pragmatic legitimacy and reducing the potential for conflict, if a considerable effort is dedicated to understanding use patterns, shaping the form in order to fit habits and routines, and communicating and explaining the

correct use, but particular users may permanently find that their specific requirements are not met or that they are segregated, affecting their trust in project sponsors and governance.

4.4 Conceptual Rhetoric

Thus type of symbolism uses discursive manipulations, storytelling or rational argumentation to attach the project to an abstract category, and hence position it in a broader network of beliefs on the relation between social goals and means (development, competitiveness, customer service). For example the Öresund bridge that connects Copenhagen to Malmö over the Öresund strait that separates Denmark from Sweden has been connected to the goal of creating a transnational region dedicated to the New Economy (Löfgren 2007). In turn, such transnational regions are seen as a means of spurring the economy and reinforcing the unity of the European Union (Dühr, Colomb and Nadin, 2010). Once such a position is established, the project becomes 'transparent' (Dreyfus 1991) for actors, as its concrete details become secondary compared to the crucial role that the project is now deemed to play in achieving overarching goals. But debates are likely during project development around the importance and worth of the goals, unless they are taken for granted, and particularly on whether the project is the right tool for achieving such goals. The worth of justifications may also diminish with changing circumstances. For example, the operability, productivity or even the possibility of transnational regions such as that involving Copenhagen and Malmö may be questioned in the face of immigration or terrorism crises that force the reintroduction of border controls.

This symbolism relies on actors' ability to abstract properties of objects and operate logically with generic categories of objects. Hence, corresponding manipulations and debates place it on the cognitive side of the processing dimension, as opposed to significations in visual language that activate emotional processes. A lot of processing involves defining the categories and clarifying their meaning, and justifying the connections between them. These strategies depend on the existence or emergence of institutionalized understandings with regards to desirable goals and strategies and vocabularies of arguments in their favour (Suchman 1995). In terms of effects, conceptual rhetoric contributes to cog-

nitively legitimate a project, by associating it to a workable set of relations between goals, actions and means.

Organization and institutional theorists have revealed that category attribution or sensegiving play a key role in strategizing, organizational change, the development of new institutions or altering existing ones, and the acquisition of resources for innovative ventures (Zott and Quy 2007). For example, sensegiving is used to define the nature of environmental change that calls for a strategic initiative, or propose a vision of the objectives to be achieved (Gioia and Chittipeddi 1991). Meaning manipulation occurs by clarifying it via sensegiving to galvanize actors' energies or, on the contrary, cultivating ambiguity in order to stimulate the adhesion of a diversity of actors. Similarly, the association of environmental change with different categories, such as opportunity or threat, can influence the direction in which attention is focused, the interpretation and communication of information, actors' participation, the timing and scope of the initiative, the level of risk taking, and the internal or external orientation of action (Dutton and Jackson 1984). Narratives are used to underscore the appropriateness of the initiatives, for example, by stressing or not their distinctiveness, function of the institutionalization of the domain and their disruptive potential (Lounsbury & Glynn 2001). Rhetoric strategies also associate the initiative with alternative institutional logics, which allows them to be considered appropriate or not, depending on whether actors want to promote or block them (Suddaby & Greenwood 2005).

This kind of conceptual manipulation and rhetoric are also evident in many major projects. The Hamburg Elbphilharmonie project was predicated on the need to create an emblematic building that would help fix the city in the memory of people everywhere and would place it on the list of global cities such as Sydney and Barcelona. The project was also presented as the flagship of the initiative for transforming the Hamburg waterfront into HafenCity, "currently Europe's largest inner city urban redevelopment project", and the prototype for a new kind of neoliberal urbanisation (Balke et al. 2017: 8). Another manipulation used to promote the Elbphilharmonie project was presenting it as a private initiative; the project was supposed to be largely paid for from private contributions, as a condition for public support. In turn, this kind of implementation and public-private partnership was presented as a symbol of an intended entrepreneurial shift

in German city management, in which Hamburg plays a pioneering role (Balke et al. 2017). Later, the extensive private involvement proved somewhat illusory in view of significant cost overruns that the Elphilharmonie project experienced, whose tab was picked by the city government.

The New Copenhagen Opera House project can also be used to illustrate this kind of symbolism, as the project was also presented as a way of revitalizing an older dock area that had become less used and as a new way in which private sponsors can contribute to create urban landmarks. But even more interesting is to underscore the inexplicable preponderance of opera houses among major urban projects, particularly in the current era when opera has become an increasingly elitist and third age pastime, favoring categories that are not typically needy (Bereson 2002). These considerations were used to develop the following proposition.

Proposition 4: ‘Conceptual rhetoric’ symbolism has low chances of attaining and establishing the corresponding cognitive legitimacy, despite the numerous strategies available for establishing it, because opponents also have at their disposal a range of alternative premises and rhetoric strategies, and can take advantage of changing circumstances to call in question the trust in project sponsors and governance.

5. Discussion and conclusions

In this paper we endeavored to clarify the concept of project symbolism by identifying various ways in which the project may symbolize something and explaining the underlying conditions, mechanisms and effects. The development of two theoretical dimensions and of the corresponding distinctions has enabled us to disentangle the various meanings that used to be lumped under terms such as symbolic, iconic, emblematic. These distinctions can sharpen the analysis of development and legitimating processes of major projects. The propositions that we developed for each type of symbolism, particularly through the caveats that each of them posit with respect to the chances of attaining legitimacy, suggest that the difficulty of deliberately shaping the project symbolism and achieving trust, as well as the complexity of developing a governance capability.

For example, immediate impression mechanisms may trigger a broad variety of reactions and metaphoric associations, which may be difficult to reconcile or even to understand due to their obscure origins in a variety of experience. This is particularly likely in projects aiming to achieve a global impact. The visual signification of a project may attract wide support from some stakeholder groups, who share or are proud to be associated with corresponding values or goals. For other stakeholders, representations may become the catalyst of a social movement to oppose the project or the values it represents, which are difficult to counter through rational arguments (del Cerro Santamaria, 2013). The functional structuring aspect may also be interpreted differently depending on the physical capacities and skills, habits and routines and location in the social space (Bourdieu 1989). Stakeholders may feel puzzled, disadvantaged or even excluded to different extents, in ways that are both difficult to understand, because of their implicit origin of the respective impressions, and to correct, especially after the project is completed. For some of them, this may lead to a deeply seated distrust of project sponsors, their intentions and governance capabilities. Finally, the conceptual rhetoric symbolism may be subject to endless battles of interpretation, advancing different arguments and connecting the project to different institutional logics.

As the Copenhagen Opera example suggests, an added complexity stems from the fact that the four categories of symbolism are intertwined in any project. Their interplay is yet to be understood and certainly constitutes an important topic for further research. In addition, various stakeholders contribute to the construction of the megaproject’s symbolic value with their own interpretations, metaphors and alternative representations. This continually transforms the project symbolism compared as the project advances. New symbols and the controversies that surround them may become a stimulus that attracts new interventions and debates. We see this process as having a broad influence on project development and execution, most notably with regards to project governance and trust among project teams. If project sponsor are not able to reconcile and guide these complex processes, the project may take a path leading to major delays and cost overruns (Merrow and Merrow, 1988; Flyvbjerg et al, 2003; Jergeas, 2008). Future research avenues could also investigate how megaprojects symbolic

legacy is related to trust and shared project culture, as suggested by Gillett and Tennent (2017).

In practical terms, this research can inform project managers of the multifaceted nature of project symbolism, as well as on actions and conditions involved in its production.

It can prepare project participants for protracted disputes and suggest strategies for reinforcing the intended symbolism, while also making them keenly aware that symbolism processes are largely autonomous and hardly amenable to rational control.

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A Review of Studies on the Impact of Institutions on the Performance of Megaprojects

ABSTRACT

Megaprojects are mainly referred to as complex projects, costing more than one billion USD. However, despite the importance of megaprojects, many of them face failure, such as delay, cost overrun, financial failure, negative impact on the local environment and society, etc. One of the main and fundamental reasons for the challenges and failures of megaprojects is the impact of institutional elements of the megaproject environment and institutional differences of its actors (including different culture and norms of project actors and stakeholders, corruption, political factors, etc.). In this paper, which is prepared as part of a Ph.D. dissertation, a literature review of 70 articles is carried out regarding the impact of institutions on the performance of megaproject. After categorizing the articles into empirical/non-empirical and based on the main subjects, this research introduces the models proposed by these articles and summarizes them in a diagram to portray an overall view of the models. Finally, the research gap is proposed for future studies including studies in developing countries, the gradual improvement of the institution in different periods, the impact of megaprojects on institutions, etc.

Keywords: Megaprojects; Infrastructure; Institution; Corruption; Performance

1. INTRODUCTION

Megaprojects are large scale and complex projects that are expensive and usually have a long duration. They take many years to be developed and built, involving multiple public and private stakeholders and actors and may affect

the lives of hundreds of thousands of people. Megaprojects, they are not just big projects, and their size and number are growing (Flyvbjerg, 2014), and the future is the world of megaprojects. Megaprojects can be seen as the wild beasts in the project world; they are hard to tame. Some megaprojects become landmarks for a country and bring significant prosperity, but some become unforgettable catastrophes (Zidane, Johansenb, & Ekambaramb, 2013).

Despite the importance of megaprojects and a large amount of money and resources that they consume, many of them face failure. Delay, cost overrun, financial failure, negative impact on the surrounding community and environment, social resistance, and institutional challenges (such as corruption) are quite common in the world of megaprojects (Flyvbjerg, 2014; Miller & Lessard, 2000). Consequently, megaprojects face many challenges. Thus, it is imperative to reduce the probability of failure and increase the chance of success in megaproject performance. For example, the Athens Olympic (2004) megaproject is known to be one of the main causes for the economic crisis of Greece after 2008 or the Eurotunnel is known to be a financially failed megaproject, despite its technical success (Flyvbjerg, 2014).

During the last two decades, many researchers and practitioners have studied megaprojects and their problems because of the large impact of megaprojects' success or failure on organizational, national, and even the regional and international economy and on the society and the environment. Flyvbjerg (2014) believes that megaprojects are a different breed of projects and have to be managed differently. If managers of conventional projects need the equivalent of a driver's license, the managers of megaprojects need the equivalent of a pilot's jumbo jet license, so

you would not want conventional project managers to manage megaprojects (Flyvbjerg, 2014). Many reasons have been discussed in the literature on the challenges of megaprojects. One of the main and fundamental reasons for the challenges of megaprojects is the impact of the institutional factors of the project environment (Levitt & Scott, 2016; Miller & Lessard, 2000). Institutional theories attract the attention of scholars that study megaprojects. It is now evident that the problem areas of megaprojects are beyond technical issues, and they must be considered as socio-technical endeavors in complex institutional frames (Biesenthal, Clegg, Mahalingam, & Sankaran, 2017).

The institutional field for a megaproject is more wide-ranging and complex than for a major project, in which duration, costs, risks and uncertainties, widely disparate actors, legal and regulatory issues, and social, economic and ecological destruction are more predictable. Widely disparate actors, each with their own resources that are critical to the project, bring with them a set of prevailing logic that is uniquely applicable to megaproject situations. Megaprojects may face certain challenges that differentiate them from normal projects, so they require different ways of organization and management (Biesenthal et al., 2017).

The idea that 'institutional management' should precede 'technical' management' has been promoted by scholars writing about international and global infrastructure projects, and scholars have advocated the importance of institutional factors in projects (Biesenthal et al., 2017).

Hence, project management can be divided into three levels (Morris & Gerald, 2011):

- Level 1: Technical, which is operational and delivery-oriented;
- Level 2: Strategic, managing projects as organizational holistic entities, to include their front-end development and definition and with a concern for value and effectiveness;
- Level 3: Institutional, managing the institutional context, creating the context and support for project success and their successful management.

Miller and Lessard (2000) believe that institutional arrangements for shaping projects are prime determinants

of success, and the most important determinant of project performance (Miller & Lessard, 2000). Considering the importance of megaprojects and their failure rate mentioned by the above scholars, and the role of institutions regarding failures (which will be discussed in the next section), the literature regarding the institutional impacts on megaprojects' performance and their effects on performance are reviewed.

The goal of this paper is to review some of the most cited articles in this realm and present an overall view of the literature on the effect of institutional impacts on megaprojects' performance and to summarize some of the most important studies in this regard.

2. BACKGROUND

2.1. Definitions of a Megaproject

In the literature, different names are found for large-scale projects, such as megaproject, international project, Giga project, large engineering project, international infrastructure project, large infrastructure project, international construction project, global project, international development project, complex project, grand-scale construction project, large project, major project, and giant project, etc. (Flyvbjerg, 2014; Grün, 2004; Ika & Donnelly, 2017; Oliomogbe & Smith, 2012; Ryan J. Orr, Scott, Levitt, & Kujala, 2011; Ruuska, Artto, Aaltonen, & Lehtonen, 2009). Although these names seem different, they possess similar characteristics that is very much common for most of them, such as long duration and very long life cycle, high cost, environmental challenges, complexity, uniqueness accompanied with high uncertainty and risks (technical, social, etc.), severe environmental impacts over the surrounding social and natural environment, and so on. (Flyvbjerg, 2014; Oliomogbe & Smith, 2012; Zidane et al., 2013).

Different figures have been proposed in the literature for the minimum cost of megaprojects, from 100 million USD to above (Oliomogbe & Smith, 2012; Sturup, 2009; US Army Corps of Engineers, 2013), but now a days, the cost of more than one billion USD is mostly accepted worldwide for megaprojects (Capka, 2004; Fiori & Kovaka, 2005; Flyvbjerg, 2014; Marrewijk, Clegg, Pitsis, & Veenwijk, 2008; Merrow, McDonnell, & Argüden, 1988; Zidane et al., 2013). A megaproject is not just a large scale project, but the dif-

ference between “megaprojects” and other large projects is the degree to which managers can reduce overall project coordination costs for handling overall project complexity through partitioning the project into more or less autonomous subprojects (Levitt & Scott, 2016).

Today, the term “megaproject” is used much more than the others.

2.2. Megaproject Challenges

Megaprojects face different challenges the most important of which include:

- Financial failure: A project may be a technical and/or technological success, but a financial failure, such as the Eurotunnel (Channel Tunnel), which has been reported by a British official report as imposing some 18 billion US\$ loss to Britain. The report states that it would have been better if the project had not been constructed because of cost overrun and low income compared to forecasted estimates (Flyvbjerg, 2014).
- Delay: Delays are a common problem for megaprojects and cause cost overruns and benefit shortfalls. For example, delays on dams are 45% on average (Flyvbjerg, 2014).
- Cost Overrun: 90% of megaprojects experience cost overrun (Flyvbjerg, 2007), and a cost overrun of more than 50% is quite usual (World Bank, 2010). A survey of 33 megaprojects worldwide, which were completed during the last 70 years show cost overrun ranging from 50% to 1900% (Flyvbjerg, 2014).
- Negative Impact on the surrounding community and environment: They may be disaster for the environment and society, as the 2004 Olympic Games in Athens, for which cost overruns and debt for Greece was a reason for the country's 2011 debt default and negatively affected the credit rating and weakening of the economy before the 2008 international financial crisis (Flyvbjerg, 2014).
- Social Resistance: Underperformance of mega-projects, such as shortfalls in benefits and delivered assets, social acceptability, regulatory compatibility, and future business opportunities may increase the resistance of the local community (Eweje, Turner, & Müller, 2012). Some-

times the local community due to the harm imposed by the proposed project to the surrounding environment witnesses protests from local or even national communities, such as the case of the protest against the high-speed rail project in Britain to save the natural Chilterns (Rozema, Cashmore, Bond, & Chilvers, 2015).

- Institutional Challenges: key megaproject actors normally come from different nations, and thus, have different institutional frameworks who must find a way to resolve existing challenging technical, contractual, cultural, and political issues (Levitt & Scott, 2016). One of the institutional challenges that shall be treated, is corruption which is very much probable in megaprojects, comparing with ordinary projects.

2.3. Definitions of Institution

Scholars have explored a wide range of societal and cultural differences between societies, which come from their historical background and culture, shared experience, informal rules, and understandings, etc. These may be observed a difference in values and beliefs, various host government policies or behavior, (i/c laws and regulations, the acquisition of property, protection of intellectual property, the overall stability of a regime, extent of corruption), the number and quality of specialized intermediary organizations that provide supportive business services, various regulations in working systems, and social systems of production. These difference and variations are because of differences in resource base and human capital, historically specific development processes, the actions of governmental entities, trade unions, employers, and business associations, competitive market, industry trade associations, and labor unions (Ryan James Orr & Scott, 2008).

The concept of the institution is widely used in social sciences such as sociology, economics, political studies, international business, accounting, social movement, etc. Its intersection with organizational studies began in the 1970s (Scott, 2014). Different but similar definitions are proposed for the term institution; some of them are presented below:

- Institutions are rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction (North, 1990)

- Institutions are symbolic frameworks that provide guidelines for behavior, and lend stability, regularity, and meaning to social life (Ryan James Orr & Scott, 2008).
- Institutions comprise regulative, normative, and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life (Scott, 2014).
- Institutions are structures (both formal and informal) or mechanisms of social order, governing the behaviors of individuals within societies. Institutions are established to avert chaos and uncertainties, and social contracts and practices, keep societies intact through averting uncertainties and potential chaos (Ng., Velasco-Acosta, & Wang, 2015).

Considering the term “Inertia” which is a physical term, a similarity may be found between inertia in physics and institution in social science.

Inertia is the property of a body by virtue of which it opposes any agency that attempts to put it in motion or, if it is moving, to change the magnitude or direction (Britanica.com)

Chaos and uncertainty are the sources that try to change or motivate the society, so it may be seen that institutions try to oppose and resist changes and chaos in the society/organizations (like inertia).

Hence, the definition of an institution in megaprojects may be proposed as:

The official/unofficial constraints that are either the result of humans' action to create a discipline in his social life or as the social environment or the reaction of humans to the natural environment, regulating the megaproject actors' behavior. Institutions affect megaprojects, and are affected by megaprojects, and similar to motivation inertia, resisting chaos, and like inertia, resisting changes and innovations in the development of megaprojects.

2.4. Institutional elements

According to the Project Management Body of Knowledge (PMBOK), projects are subject to environmental factors, the conditions that are not under the control of the project team, and they influence, constrain, or direct the project. These conditions can be internal and/or external to the organization. Out of the environmental factors that are internal to project organization, factors such as organizational culture, structure, and governance, are important (that may be considered as institutional factors). For the environmental factors that are external to a project, the PMBOK guide introduces factors such as marketplace conditions, social and cultural influences, and issues, legal restrictions, commercial databases, government or industry standards, financial considerations, and physical environmental elements (PMI, 2017). All of these factors introduce the institutional elements of the project environment.

Scott (2014) classified institutional elements into three types of pillars, constraining and guiding social behavior. The three elements form a continuum moving “from the conscious to the unconscious, from the legally enforced to the taken for granted” (Scott, 2014). This categorization is accepted mainly and referred to by many scholars (Ryan James Orr & Scott, 2008):

- Regulative elements include formal regulations and rules that govern behavior such as constitutions, laws, and property rights. Regulations may be created and maintained by transnational authorities, nation-states, or provinces and local regimes with the power to create rules and sanction deviance.
- Normative elements include the informal norms, values, standards, roles, conventions, practices, taboos, customs, traditions, and codes of conduct that guide behavior and decision and include both values and norms. Values are conceptions of the preferred or the desirable. Norms specify how things should be done and define legitimate means to pursue valued ends. Normative systems define goals and objectives.
- Cultural-cognitive elements are operating mechanisms of the mind, and include shared beliefs, categories, iden-

tities, schemas, scripts, heuristics, logics of action, and mental models. These elements are cultural in the sense that social reality is referenced and rationalized against external symbolic frameworks, and are cognitive in the sense that social reality is interpreted and constructed through internalized frames of creating meaning. Culture may mean either the personal or societal culture of individuals/people of the organization. It should be noted that in real life, normative and cultural-cognitive elements may overlap and are not easily distinguished.

2.5. Interrelation of Institutions and Megaprojects

Miller and Lessard (2000) in their extensive empirical study of more than sixty megaprojects worldwide (known as the IMEC Research Program) came to the conclusion that institutional arrangements for shaping projects are prime determinants of success, and the presence of coherent and without a doubt, well-developed institutional arrangements is the most important determinant of project performance (Miller & Lessard, 2000). Institutional arrangements are sets of laws, regulations, and agreed to practices that form symbiotic relationships and provide effective ways of developing projects. The flexibility provided by institutional arrangements helps many projects survive from unforeseen events.

Moreover, large infrastructure construction entails a complex assortment of firms, governments and NGOs and generally different players that operate more and more at a transnational or global level, each of them possessing their own institutional background and logics (Scott, 2012). Therefore, they may face conflicts due to differences in the actors' institutional logics that influence the performance of megaprojects.

2.6. Corruption

Corruption is the abuse of entrusted power for private gain. It can be classified as grand, petty and political, depending on the amounts of money lost and the sector where it occurs. Corruption corrodes the fabric of society. It undermines people's trust in political and economic systems, institutions and leaders. It can cost people their freedom, health, money and sometimes their lives (Transparency International, 2018). Corruption is an institutional problem

(Ika, 2012), and affects the performance of megaprojects (Locatelli, Mariani, Sainati, & Greco, 2017). Studies show that countries with more corruption tend to have inferior infrastructures (Gillanders, 2014). Corruption is relevant for large and uncommon projects where the public sector acts as a client/owner or even as the main contractor. Corruption worsens cost and time performance and undermines the benefits delivered (Locatelli et al., 2017). American Society of Civil Engineers claim that yearly corruption is estimated to be nearly 340 Billion USD worldwide in construction projects. Corruption such as bribery, embezzlement, kickbacks and fraud in construction projects undermines the benefits of infrastructure (Sohail (Khan) & Cavill, 2006).

2.7. The Performance of Megaprojects

The traditional definition for project performance is the iron triangle (time, cost, scope, while maintaining quality); however, such a definition is insufficient and broader criteria should be considered (Patanakul, Kwak, Zwikael, & Liu, 2016; Toor & Ogunlana, 2010). Megaproject performance may be studied from two points of view, internal performance (project management view), and external performance (stakeholders' view) (Golini, Kalchschmidt, & Landoni, 2014). Moreover, the EU Megaprojects Cost Action study shows that the iron triangle is still a proper method for measuring performance (Misic & Radujkovic, 2015).

In addition to the above, other articles also propose a broader view to megaproject performance, so the performance may be categorized in two group (Aaltonen & Kujala, 2016; Ika, Diallo, & Thuillier, 2012; Lessard, Sakhrani, & Miller, 2014; Miller & Lessard, 2000; Sirisomboonsuk, Ching Gu, Cao, & Burns, 2017):

- Internal Performance (Efficiency): It is from the project management point of view and can be measured as an iron triangle (cost, time, scope by keeping quality), simply, doing the project right.
- External Performance (Effectiveness or success): It is from the stakeholders' point of view, and simply is doing the right project, including safety, social and economic benefit, implementing according to stakeholders' expectations, minimum conflicts, minimum construction and operational cost, achieving project long-term goals, engaging

stakeholders, economic sustainability, local community acceptance, implementing without corruption, etc.

3. RESEARCH QUESTIONS AND OBJECTIVES

The main objective of this review paper is identifying and categorizing the main studies regarding the impact of institutions (and its different elements) on megaproject performance, whether internal performance (from project management point of view) or external performance (from stakeholders point of view).

Therefore, the main questions are as follows:

- Do institutions influence megaproject performance, and what are the impacts?
- What are the models of the impact of institutions on megaproject performance?
- What are the research gaps to be studied in future research in this regard?

4. RESEARCH METHODOLOGY

As mentioned before, one of the elements of the institution is culture and some papers, especially in the 2000s concentrated on culture and its impact on projects. Therefore, the search was narrowed to find articles regarding the impact of institution and culture on megaprojects, and using the snowball method, other referred papers were also found. This search returned more than 150 articles from 2000 until 2017.

A brief review of the abstract of the papers was conducted to filter out less related or unrelated papers. Although there are many articles about institutional impacts, the papers were screened for those listed in JCR2018 and Scopus2018 lists, and Scopus Congress Papers, PMI Congress Papers, Ph.D. dissertations, books, and organizational reports. The abstracts of the articles were examined, and out of them, 70 articles were found to be more relevant regarding the impact of institution/culture on megaproject/construction project performance and the impact of megaprojects on in-

stitutions. Since the term "institution" is widely used in varied fields, thus, relevant papers are published in many journals in different fields. Subsequently, 70 articles were studied, more deeply, and the subjects discussed in the articles were categorized.

First, the methods of these researches were divided into empirical and non-empirical. Second, the main keyword of the papers was found. Third, the main subject of the papers was classified. In the fourth step, all discussions and themes of the articles were categorized, because an article may be multi-theme and have other subjects discussed, except the main subject. For example, the main subject of a paper may be Public-Private Partnership (PPP), but it may also discuss the impact of institutions on the project, the impact of institutions on project performance, and the impact of a megaproject on the institutional environment. In the fifth step, the output and conclusion of the papers were discussed and analyzed.

Finally, the research gaps were extracted by concentrating on the countries that their institutions were not studied and criticizing the institutional elements.

5. DISCUSSION

As mentioned in the research methodology, in this section, the reviewed literature are categorized and analyzed in five steps and in different categories.

5.1. Empirical/Non-Empirical researches

Out of the 70 articles studied, 48 of them were empirical, and 24 were non-empirical/literature reviews (two articles used both types of study). This shows that empirical studies are in majority (nearly 67%) in the relevant studies, although literature review is also an important approach in studying the institutional impact on megaprojects.

These research may be classified in two groups, those that are multi-national, which compare institutional factors in projects in more than eight countries, and those that are more specific, which survey one, two, or up to maximum four countries.

Multi-national researches:

Examples of this research group are mentioned below:

One of the first and most extensive empirical researches that have been done regarding the impact of institutions on megaproject success is the IMEC research program by a number of institutes that surveyed 61 megaprojects worldwide. These projects are constructed in the USA and Canada (17 projects), Europe (21 projects, most of them in France and Britain), 10 projects in Latin America (Brazil with five projects and Chile with three projects have the majority), and 13 projects located in south and south-east Asia (Japan, Malaysia and Thailand each with three projects, and Philippines, Indonesia, Hong Kong) (Miller & Lessard, 2000). It may be observed that this extensive research did not include east and central Asian and African countries.

Although fifty years ago, the main challenges to large infrastructure projects were technical or scientific, today, the greatest challenges of such projects are almost social and/or political. By studying the opposition of local people to 11 oil and gas pipelines passing 16 developing countries, McAdam et al. (2010) concluded that the host country shall be consulted and compensated (McAdam et al., 2010).

In another notable study of 15 international construction/engineering companies working in 10 countries including the USA and some European and Asian countries, the interviewees emphasized that learning and applying institutional knowledge is very important for the success of international megaprojects (Javernick-Will & Levitt, 2010).

Researches in specific countries

Most studies studied the impact of the institutional environment on projects in one country, mostly in the USA, Canada, European countries, and a few studies were carried out in Japan, China, India, and some Asian and Latin American countries. A few studies compared the impact of the institutional environment in two to four different countries. For example, a study showed the challenges of a US construction company when entering the French and German markets, which was rooted in different regulations, aesthetic values, norms and historical methods of construction, nature and

environment, and even preferences between Americans and Europeans (French/German) (A. Mahalingam & R.E. Levitt, 2007). Other studies compare the institutional impact on projects in India and Taiwan (Mahalingam, 2005), Kenya and UK (Ochieng & Price, 2010b), and France and the Netherlands (de Bony, 2010). Another article concludes the impact of cultural differences on American and Japanese team performance (Horii, Jin, & Levitt, 2005).

It should be noted that although the researches span worldwide, most of the empirical research is conducted in developed countries in North America, north and west Europe, and Japan. In developing countries, very few empirical researches are done mainly in eastern Europe, Brazil, China, India, and some other Asian and Latin American countries. A few studies were also conducted in African countries.

As we will mention later, most of the models proposed by these articles are extracted from empirical researches, which shows the importance of empirical researches in theorizing these models.

Regarding the data collection tools, out of 48 empirical studies, the majority (36 articles) used interviews, 12 cases used questionnaires, and four of the studies employed the mixed method. Four articles used none of the tools but used World Bank data, project data, and authors' experiences. Out of 48 empirical studies, 34 were case studies (either single case or multi-case study), which shows the major research strategy for empirical studies in this field of research. It may be because of the fact that it is easier and much more rigorous for scholars to draw implications from real cases than from another research strategy.

Regarding non-empirical researches, for example, one considerable research was conducted by studying the relationship between deployment of project management and cultural factors with the country development indicator (GDP/Capita) in 74 countries (Bredillet, Yatim, & Ruiz, 2010). Other non-empirical researches mainly have conclusions on the impact of institutional factors on project performance in the form of phrases, and only two of them presented a model as an output, which shows the impact of institutions on international project failure (Ika, 2012) (Anantatmula & Thomas, 2010)

5.2. Categorizing the titles of the reviewed articles

Although the main subjects of these papers are about the impact of institution and culture on projects, the title of all the articles may not reflect institution/culture directly. Regarding the title, 13 categories were found. Discussion about the focus of these papers is presented in the next section.

Table 1 shows the number of articles in each title category that were reviewed in this study.

Table 1. Number of articles related to the review in the study

Titles of reviewed articles	No. of Articles	Example of References
Impact of Institution/Culture on Project Performance /Success /Failure	7	(Ankrah, 2007; Ika et al., 2012; Ika & Donnelly, 2017; Kivrak, Ross, Arslan, & Tuncan, 2009; Lückmann, 2015; Miller & Lessard, 2000; Nguyen & Watanabe, 2017)
Impact on Project management / Multi-culture Team or emergence of project management discipline	28	(Ainamo et al., 2010; Anantatmula, 2010; Anbari et al., 2009; Biesenthal et al., 2017; Bresnan, 2015; Chevrier, 2003; Eberlein, 2008; Engwall, 2003; Makilouko, 2004; Marrewijk, 2007; Pheng & Leong, 2000; Wang & Liu, 2007; Yung, 2012; Zwikael, Shimizu, & Globerson, 2005)
Megaproject Stakeholders' Institutional Impact	7	(Aaltonen & Kujala, 2010; Aaltonen & Sivonen, 2009; Lückmann & Färber, 2016; Rozema et al., 2015; Suddaby & Viale, 2011).
Institutional Difference/conflicts (due to varied nationalities, organization culture, environmental conditions of megaproject actors 'countries	6	(A. Mahalingam & R.E. Levitt, 2007; A. Mahalingam & R.E. Levitt, 2007; Ryan James Orr & Scott, 2008; Wong, Hakan, Taylor, & Levitt, 2010).
project governance and the interrelation with institution/culture	6	(Badewi & Shehab, 2015; Brunet & Aubry, 2016; Koch & Buser, 2006; Marrewijk & Smits, 2015; Ng. et al., 2015; Sanderson, 2012).
Corruption (an institutional aspect , affecting megaprojects performance)	4	(GIACC, 2008; Gillanders, 2014; Locatelli et al., 2017; Tabish & Jha, 2012)
Institutional impacts on Public-Private Partnership megaprojects	3	(Monios & Lambert, 2013; Opara, Elloumi, Okafor, & Warsame, 2017; Zhang, Gao, Feng, & Sun, 2014; Zhang & Liang, 2008)
Institutional Challenges	2	(Levitt & Scott, 2016; Ryan J. Orr et al., 2011)
Institutional Knowledge	2	(Javernick-Will & Levitt, 2010; Javernick-Will & Scott, 2010).
Contract & institution	2	(C. F. Chan, 2010; E. H. W. Chan & Tse, 2003).
Institutional Cost	1	(Mahalingam, 2005)
Institutional impact on International JV	1	(Ozorhon, Ardit, Dikmen, & Birgonul, 2008).
Project Culture	1	(Zuo, 2008)
Total	70	

5.3. Main focuses of the reviewed articles

Although each article has a main subject that is reflected in the article title, by going through the texts, it could be seen that each article may be multi-theme and possess more than one major subject reflected in the title of the article. We found the below frequency of major discussions in the reviewed articles (if we mention institution, it may also include culture as a subsidiary of institution):

- **Impact of Institutions on Megaprojects:** In 28 articles, the general impact of institutions on megaprojects was discussed and concluded. For example, a study of a port project in a Canadian state showed how institutions changed the planning paradigm of infrastructures in that state, and how institutions have a positive and negative impact on megaprojects. This paper discusses that apart from the economic potentials of this port, the project was driven by institutions and political support, and forced the stakeholders to learn and convert institutional barriers into drivers that facilitate and even accelerate institutional change (Ng, et al., 2015).

In the study of Panama Channel expansion project, cultural activities such as ritualizing the bid-winning ceremony, labeling people according to national and organizational cultures were observed to influence the project (Marrewijk & Smits, 2015).

Another study compares Chinese and UK construction project managers' conceptions of their work. It concluded that the Chinese emphasized commercial awareness and UK managers focused on health and safety, which arises from the social structural differences in the two nations. Moreover, the Chinese attention to relationships and concern for their company and the UK managers' attention to project contract are because of the cultural differences between the two nations (Chen, Partington, & Qiang, 2009).

- **Institutional Challenges of Megaprojects:** Seven articles discussed the challenges of megaprojects that are created due to institutional environment/factors, which in turn actually affect project performance, for example, a study of a megaproject in Norway, which shows that in different institutional environments, there are many management challenges for coordination between

project actors (Dille & Soderlund, 2013). Orr et al. (2011) concluded that global projects face new challenges, such as coordination costs, time limitations, etc. (Ryan J. Orr et al., 2011). Levitt and Scott (2016) proposed that overcoming the institutional challenges of global megaprojects is possible through governance mechanisms, including enhanced regulative, normative, and cultural governance (Levitt & Scott, 2016).

- **Impact of Institutions on Megaproject Performance:**

31 articles discussed directly the impact of institutions on the performance of megaprojects. Twelve articles presented a model as the output of the research and 19 others offered only a conclusion without presenting any specific model. This will be discussed more in the next section.

- **Institutional conflict:**

Eight articles discussed the conflicts arising because of the differences of the institution between actors that are often from different nationalities. Cultural issues are expected to contribute to conflicts among parties in an international project and increase difficulties for the management of the project (E. H. W. Chan & Tse, 2003). Misjudgments and misunderstandings of unexpected nature give rise to misconceptions, confusion, and false impressions, and generate unanticipated institutional costs, such as resource costs, time costs, relational friction, and reputational damage (Ryan James Orr & Scott, 2008). Global projects that involve collaboration between participants from multiple countries often result in extra costs due to cross-national interactions, and institutional differences contribute to these costs (A. Mahalingam & R.E. Levitt, 2007). Therefore, conflicts also influence project performance.

- **Impact of Institutions on project management:**

Thirty-three articles discussed managing projects and managing project teams that are usually multinational/multicultural. Consequently, the impact on project management may affect the project performance. This impact varies in different articles:

The first group presents a general view on the relation of institution and project management. For example, Johnson (2013) believes that institutional factors such as the need for legal separation between the government and the industry created a situation in which project man-

agement evolved (Johnson, 2013) or, Morris and Gerald (2011) proposed that other than managing the technical level and strategic level of projects, management should be done at the institutional level of the project (Morris & Gerald, 2011).

A second group concluded the impact of institutions on project management, such as a study of two rail projects in China and Taiwan that concluded that host country institutions, such as political cultures and industrial structures determined the decisions for project arrangements, including delivery method, financing, participants' roles, the degree of private and foreign participation, and organization (Chi & Javernick-Will, 2011).

Another group concluded the importance of managing cultural differences. For example, Kivrak et al. (2009) through interview of 11 UK senior managers with years of experience in international projects concluded that successfully managing cultural differences is one of the key elements in project success, and ignoring and mismanaging cultural differences is an important cause of project failure (Kivrak et al., 2009).

The fourth group of articles studies the impact of cultural differences on multi-cultural project team management. An example is a questionnaire survey on a number of project leaders from the UK and Kenya. It indicated that cultural differences could influence multi-cultural team performance, and project leaders need to possess the attributes of building trust among team members and providing good planning and good communication techniques (Ochieng & Price, 2010a).

- **Impact of megaprojects on institutions:** Megaprojects are normally so large scale and impressive that they may also affect the institutions of the host country. Sometimes they modify institutions (laws and regulation, or norms or culture) to enable the project to become operative. Six articles have discussed this matter. For example, Miller and Lessard (through the IMEC project) concluded that some megaprojects changed the laws of the host country such as law modification in Turkey for enabling BOT projects in the 1990s (Miller & Lessard, 2000). Sometimes this change is limited to simply modifying the norms and planning methods for megaproject construction (Ng. et al., 2015).

Sometimes the lessons learned from megaprojects are used to improve the regulations or organizational cultures for future megaprojects as seen in PPP projects in some countries, examples of which are observed in the evolution of Chinese institutions (Zhang et al., 2014), or in the USA through the "Heartland Intermodal Corridor" megaproject (Monios & Lambert, 2013).

In a study of three highway projects in Alberta, Canada, and under DBFM (Design-Build-Finance-Maintain) contracts that started between 2003 until 2011, the researchers concluded that the lessons learned from previous projects had a positive effect on subsequent projects by improving the institutional environment (Opara et al., 2017).

Sometimes the impacts of megaprojects are on local institutions of surrounding communities, such as traffic noise, air pollution, pollution of waterways or groundwater, the arrival of a large number of construction workers and camp followers such as alcohol, drugs, prostitution, and other social ills (Levitt & Scott, 2016).

- **Proposals to treat institutional environment:** Twenty-one articles not only discussed institutional impacts but also presented proposals to treat the institutional environment and its impact on megaproject performance, examples of which are offered below:

Through the study of three highway projects in Canada, Opara et al. (2017) concluded that political willingness and support, business environment, and organizational capacity are pre-requisites for PPP success (Opara et al., 2017).

Levitt and Scott (2016) proposed mixing and matching governance mechanisms to overcome institutional challenges, such as enhanced legal-contractual mechanisms, shared vision for project partners, early engagement of participants in social settings that build trust, fair process in decision-making, building a strong project culture, etc. (Levitt & Scott, 2016).

According to a study by Ika (2012) on some African development projects, he concluded that project management faces three problems, 1) Structural/contextual problems; 2) Institutional and/or sustainability problems,

and 3) Managerial and/or organizational problems, which create some traps that are the causes of project failure. These traps are one-size-fits-all traps, accountability-for-result trap, lack-of-PM-capacity trap, and cultural trap. To overcome these traps, he proposes a) Drawing insights from alternative project management approaches; b) Refocusing on managing objectives for long-term results; c) Improving project supervision by aid agencies, and d) Tailoring the project management approach to African values and cultures (Ika, 2012).

- **Corruption:** Four of the reviewed articles concentrated on corruption in megaprojects and its impact on the performance of megaprojects. Examples of these articles are as follows. Locatelli et al. (2017) studied the impact of country's corruption on project performance using the institutional theory to introduce the concept of "corrupt project context" and, by using the case study of the Italian high-speed railways, concluded that the significantly higher cost of the Italian railway (per Km) compared with similar cases in France and Germany is because of the higher corruption context of Italy compared to the other two countries. Thus, a deviant culture such as the tolerance of corruption becomes accepted and causes counterproductive behaviors. Politicians play necessary "political games" and maintain important contacts to ensure broad support despite terrible project management performances (Locatelli et al., 2017). Through literature review and collecting 105 questionnaire surveys, Tabish and Jha (2012) developed a research model showing that anti-corruption strategies lead to corruption-free performance in public construction projects. The anti-corruption strategies were categorized as 1) Leadership (e.g. praise for working honestly); 2) Rules and regulations (rules not to impose restrictions); 3) Training (e.g. training to help prevent corrupt practices), and 4) Fear of punishment (e.g. fear of suspension) (Tabish & Jha, 2012)

5.4. The output of articles regarding the impact of institution/culture on megaproject performance

As mentioned above, 31 articles concentrated on the impact of institution/culture on megaproject performance. Out of these articles, 12 articles proposed a model (theoretical or conceptual) showing these impacts and 19 articles just

presented the impacts in terms of phrases and conclusions. In addition to the above 12 models, three papers presented models regarding institutional conflicts and three articles presented models that show the impact of institutions on project management (which indirectly affects project performance). Therefore, we found 18 models that directly or indirectly show the impact of institutional/cultural elements of project environment on megaproject performances. As mentioned before, 16 of these models are the outcomes of empirical researches, and two were the result of literature reviews.

Some of the articles did not present any model as the output but merely offered conclusions regarding the impact of institutions on project performance in the form of propositions, which mostly come from non-empirical researches. Some examples of these concluded propositions are as follows:

- Institutional arrangement and developed laws and regulations are the most important factor in project performance (Miller & Lessard, 2000).
- Understanding cultural factors helps to reduce conflicts and differences and also increases efficiency and profit making of international construction projects (E. H. W. Chan & Tse, 2003).
- Institutional complexity impact project progress and outcomes (Koivu, Tukiainen, Nummelin, Atkin, & Tainio, 2004).
- In global projects, institutional differences (language, believes, norms, work methods, professional roles, industrial organizations, etc.) of different nationalities of project actors may create conflict and misunderstanding that leads to cost overrun, delay, and reduced quality (Wong et al., 2010).
- Alternative explanations of megaproject underperformance are a) under-estimating costs, over-estimating benefits, b) misaligned and underdeveloped governance, c) diverse project cultures and rationalities (Sanderson, 2012).
- Institutions have a positive and negative impact on megaproject planning (Ng. et al., 2015)

5.5. Models presenting the impact of institution/culture on megaproject performance

The following articles presented their conclusion for the impact of institution/culture on megaproject performance in the form of models or some types of the graphical framework:

1. By studying the Hong Kong construction industry, a theoretical model for the relation between intra- and inter-organizational culture and project success emerged. It showed that if project participants come largely from a collectivist society, they treat members of other organizations as the out-group. Instead, they feel more strongly with their own organization and morally obligated to cooperate with their in-group which increases the possibility of conflict with out-group individuals (Phua & Rowlinson, 2003).
2. A model shows that institutional complexity and the difference between management and leadership styles and work practices of two different project management cultures in a global megaproject may induce conflict and affect project performance (Koivu et al., 2004).
3. Ankrah (2007) in a study of some UK construction companies concluded a conceptual model, which showed that organizational culture influences cultural dimensions such as leadership, commitment to client and workforce, teamwork, and work quality, which in turn affect project performance (Ankrah, 2007).
4. Another model shows the impact of the organizational and national culture of the company and culture of the host country on project performance. For example, the host country's culture is introduced as familiarity with items such as language, business practice, political and legal systems, economic environment, industry structure, and national culture (Ozorhon et al., 2008).
5. A theoretical framework presents the relation between project culture (integrative or fragmented, cooperative or adversarial, goal-oriented or process-oriented, people-oriented or task-oriented, flexible or stable culture) and project performance (Zuo, 2008).
6. A model shows that institutional factors (such as the global business environment, legal and political issues, and cultural values) affect the performance of global projects (Anantatmula & Thomas, 2010).
7. The descriptive framework of managing the influence of cultures on projects (Kuusisto, 2012).
8. Ika (2012) presented a model that shows the relation of project management problems (i/c institutional/sustainability problems, structural/contextual problems, management/organizational problems) and project management traps (Ika, 2012).
9. A study on Indian megaprojects proposed a model for the impact of anti-corruption strategies on the performance of construction projects. These strategies are recognized as leadership, rules and regulations, training, and fear of punishment (Tabish & Jha, 2012).
10. Zhang et al. (2014) showed that after the introduction of PPP in China, adaptation and lessons learned led to the maturity and institutional evolution of the environment for PPP in China (Zhang et al., 2014).
11. Model, elaborating success conditions of international development projects (i/c institutional conditions) (Ika & Donnelly, 2017).
12. Model showing the institutional elements affecting PPP projects in Alberta, Canada (Opara et al., 2017).

The above models all concentrated on institution impact in a static mode, without discussing the dynamism of institutional improvement due to older megaprojects that improve the performance of future megaprojects. Nonetheless, two of the above papers presented the model for improvement of institutions and its effect on project performance; the first one is institution evolving rout for PPP in China, and the second is the effect of lessons learned to improve the institutional environment for next PPP project in Alberta (Opara et al., 2017).

Some articles also presented models regarding institutional conflicts/differences (which in turn, affect project performance):

13. The process of resolution of institutional conflicts in global projects (Mahalingam, 2005).
14. Using institutional theory as a framework for understanding and analyzing conflicts in global projects (A. Mahalingam & R.E. Levitt, 2007).
15. A generic narrative model to understand how institutional exceptions arise and are resolved (Ryan James Orr & Scott, 2008).
16. A conceptual model for the effect of political culture and industrial structure on project management (Chi & Javernick-Will, 2011).
17. The impact of cultural differences on construction project management (Furber, Smith, & Crapper, 2012).
18. Framework for the impact of cultural challenges on the management of global project teams (Rodrigues & Sbragia, 2013).

Furthermore, the following articles presented models regarding the impact of institutional differences on project management (which affect project performance):

5.6. Summary of the reviewed articles

Figure 1 shows a diagram that summarizes the eighteen reviewed articles of Section 5.6, which have presented models relating institutions and project performance directly, or indirectly.

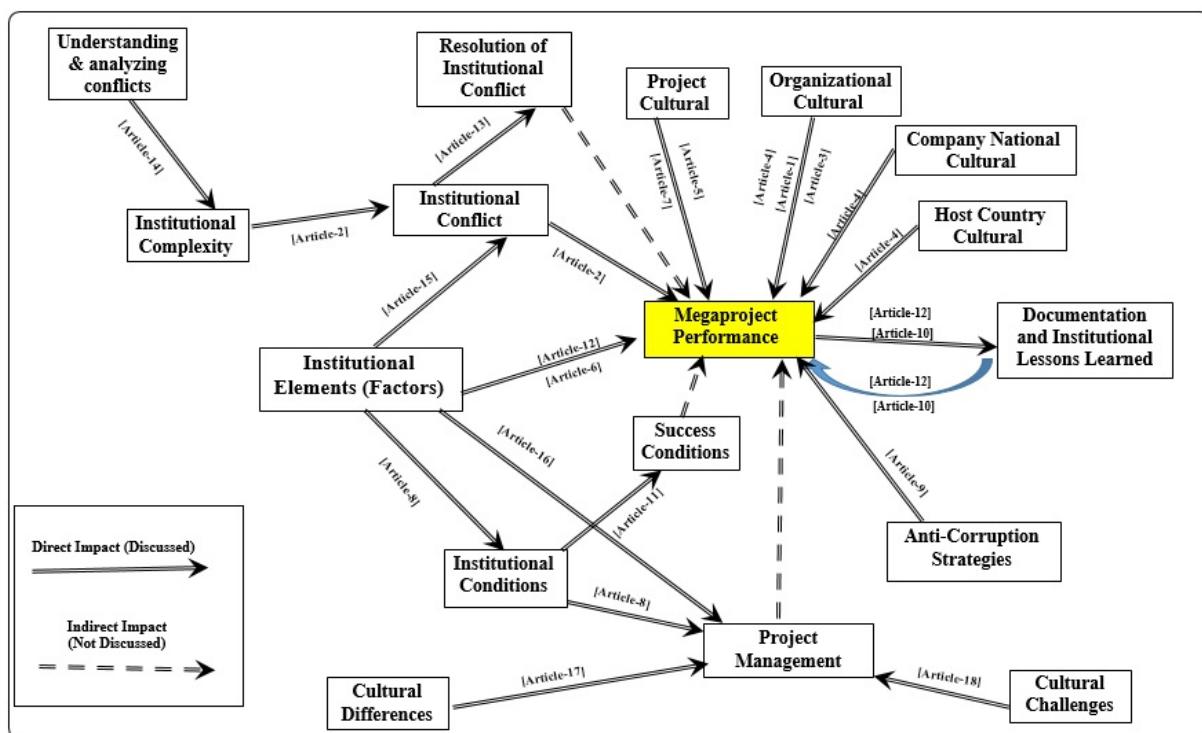


Figure 1. Diagram of study models relevant to the impact of institutions on megaproject performances (authors)

An arrow shows article number (as mentioned in Section 5.6), discussing the mention relation or impact. Evidently corruption is one of several institutional factors that impact on the performance of megaprojects.

Some relations are not directly discussed in the articles and maybe concluded logically, which are shown by dashed arrows. These indirect relations include the impact of project management, the impact of success criteria, and the impact of conflict resolution on megaproject performance.

For example, some articles concluded that the culture of the project, organization, or host country might affect megaproject performance. Some articles indicate that the institutional elements either directly affect performance, or the impact on project management or may induce institutional conflicts, which indirectly affects megaproject performance

6. CONCLUSION

Corruption in megaprojects shall be considered in a broader context, as institutional environment that have a significant impact on the performance of megaprojects. The literature review conducted in this paper covers some of the main articles in the area of impact of institutions on megaproject performance. Out of more than 150 relevant articles published between 2000 and 2017, we screened those listed in JCR2018 and Scopus2018 lists, and Scopus Congress papers, PMI Congress Papers, Ph.D. dissertations, organization reports, and books, which filtered the results to 70 articles, which were subsequently categorized in five ways.

Empirical/non-empirical categorization showed that the majority (67%) of the articles are empirical and most of the models have emerged from empirical researches (16 of total 18 models).

The main keyword used in each of the articles are an institution (33 articles), culture (31 articles), corruption (4 articles), context (one article), and local community (one article). Previously, the term "culture" was mostly used and recently the number of articles with the keyword "institution" is growing that could be the sign of a broader view regarding the institution. Corruption – as an institutional problem – is going to attract more consideration of scholars in the field of megaprojects.

Out of the 70 articles, the most frequent article title was the impact of institutions on project management and multi-culture teams (28 articles), and other categories of article titles' frequency were from seven to one article..

Since an article maybe multi-themed and present discussion on more than one subject, the articles were then categorized according to their total discussions: impact of institutions on megaprojects (30 articles), impact of institutions on megaproject performance (31), institutional conflict (8), institutional challenges of megaprojects (7), impact of institutions on project management (33), impact of megaprojects on institutions (6), proposals for treating institutional environment (21), and corruption (4 articles).

At the last stage, the outputs of the articles regarding the impact of institution/culture on megaproject performance were studied. Out of 31 articles concentrating on the impact of institution/culture on megaproject performance, 12 articles proposed a model (theoretical or conceptual) showing these impacts, and 19 articles just presented the impact in terms of sentences and conclusion.

The above models concentrated on the impact of the institution in a static mode, without discussing the dynamism of institutional improvement due to older megaprojects that improve the performance of the future megaprojects. Nonetheless, two of the previous papers presented the model for improvement of institutions and its effect on project performance. Moreover, out of the above 12 models, three papers presented models regarding institutional conflicts (which in turn, affect project performance) and three articles presented models on the impact of institutional differences on project management (which affect project performance). Therefore, 18 articles were recognized regarding the impact of institution/culture on megaproject performance (directly or indirectly). A simplified summary of the models is provided in Figure 1.

Although it was stated that corruption corrodes 340 billion USD yearly in the worldwide construction industry, and thus is one of the main reasons of cost overrun and failure of construction projects/megaprojects, table 1 and figure 1 shows that corruption has not attracted enough consideration of scholars for research in the field of project management. Therefore it is proposed to be a major field for future studies.

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IPMA World Map



ALGERIA	CROATIA	ICELAND	NEPAL	SOUTH AFRICA
ARGENTINA	CYPRUS	INDIA	NIGERIA	SOUTH KOREA
AUSTRALIA	CZECH REPUBLIC	INDONESIA	NORWAY	SPAIN
AUSTRIA	DENMARK	IRAN	PANAMA	SWEDEN
AZERBAIJAN	DOMINICAN REPUBLIC	IRELAND	PARAGUAY	SWITZERLAND
BOLIVIA	ECUADOR	ITALY	PERU	TAIWAN (CHINA)
BOSNIA AND HERZEGOVINA	EGYPT	JAPAN	PHILIPPINES	NETHERLANDS
BRAZIL	ESTONIA	KAZAKHSTAN	POLAND	TURKEY
BULGARIA	FINLAND	KOSOVO	PORTUGAL	UKRAINE
CANADA	FRANCE	LATVIA	ROMANIA	UNITED KINGDOM
CHILE	GEORGIA	LITHUANIA	RUSSIA	UNITED STATES
CHINA	GERMANY	MALAYSIA	SERBIA	URUGUAY
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