Conventions for Coordinating Large Agile Projects

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Abstract. There is no universal way to coordinate Agile teams in large development projects because they have unique problems. This implies that the best way to coordinate the teams is to ask them how they want to be managed given a set of constraints. This requires particular communication and negotiation skills in the leadership team, which we discuss in this article. We describe the skills as a set of conventions, founded on the argument that every organization is a complex adaptive system and should therefore be analyzed from multiple system perspectives. We investigate scientific models for managing complexity and evaluate their usefulness through qualitative interviews with 14 managers in large private and public organizations in Saudi Arabia. We conclude that a set of proposed conventions could facilitate coordination by functioning as a supportive context enabling managers to apply various system perspectives simultaneously.

Keywords: Management, Systems thinking, Complexity

1 Introduction

Many Agile teams operate within larger, complex organizational environments. Their capacity for high performance depends largely on their leaders' ability to manage the various contexts of complexity within and across the teams. Consequently, leaders must be prepared to dynamically and flexibly shift their leadership style to effectively lead the teams and the organization as a whole [27].

There exist many models for how systems thinking can be used to deal with organizational complexity [16]. However, several researchers have described the constraints with using individual systems models disjointedly because they build on different paradigms. For instance, Flood and Romm [14] describe the dangers of adopting one perspective and instead advocate an approach called "Total Systems Intervention" to avoid getting stuck in one perspective of a system that does not cover all aspects of its subsystems. Jackson [16] resonates with this and promotes holistic system thinking as an ability to analyze organizations from different viewpoints by combining system models to ensure that the parts function properly together to serve the needs of the whole. Snowden and Boone [27] also present methods for dealing with the emergent properties of complex social systems, where the setting of system boundaries combined with increasing levels of interaction and communication enable

managers to probe and make sense of a variety of complexities and respond accordingly as they emerge.

Today, many researchers have recognized the need for pluralism and advocate the use of a multi-methodology, which implies that several system models are combined when managing large complex organizations such as large software projects consisting of many teams. The problem is how a multi-methodology can be applied effectively in practice. For instance, Brocklesby [6] describes the cognitive difficulties while working across paradigms. We cannot expect managers to be experts in how to combine a number of abstract system models simultaneously. On the contrary, they need to make fast practicable decisions. Speed is particularly important in Agile contexts where the development cycle can be as fast as 2 weeks. Moreover, we cannot expect managers alone to know all the drivers of complexity involved in coordinating many development teams. It requires collective knowledge [24]. Hence, we draw two conclusions: managers must be (a) familiar with the most relevant theories, opportunities and threats of coordinating complex organizations, and (b) able to create environments where communication can grow and solutions be exploited in interaction with the teams to make faster and more actionable decisions. In practice, this indicates that a useful way to coordinate the teams in large, complex development projects is to ask each team how they want to be managed given a set of constraints. This requires relevant communication and negotiation skills in the leadership team, which we address in this paper.

The overarching goal of this paper is to argue for the usefulness of a proposed set of conventions for mastering complexity in large Agile projects. We investigate scientific models for facilitating coordination in large, complex organizations and evaluate their usefulness through qualitative interviews with 14 managers in public and private organizations in Saudi Arabia. Our goal is to (a) elicit and synthesize a set of high-level conventions providing support for coordinating many Agile development teams, in particular through enhanced communication, and (b) find empirical evidence for their need and usefulness.

The remainder of this paper is: Section 2 describes related research. Section 3 summarizes our research method. Section 4 presents the candidate conventions. Sections 5 and 6 contain the results of an evaluation and a discussion, respectively. Section 7 provides concluding remarks and suggestions of future research directions.

2   Related Research

Based on the literature in systems thinking and the management of complexity, e.g. [8][16][17][26], our conclusion is that no single method or model alone can solve the problem of coordinating large Agile projects. Generally, different contexts call for different kinds of responses. The more complex, all the more communication and interaction is generally needed to be able act effectively as a leader [27]. A secondary problem arises as a result of this. How can managers increase communication and interact more effectively with their teams when they do not have consistent models telling them how to coordinate the dynamics of Agile projects? There seems to be a lack of a common playground or context permitting managers to understand the

totality of what is going on in these complex dynamic organizations. Because most management approaches (not based on systems thinking) generally build on reductionist models describing formal routines for fixed systems, they cannot deal with the dynamics and interdependencies in a complex system [16]. Hence, they can be seen as the antithesis of Agility. Instead, the management support models need to be formulated in a way that they can be applied in ever changing dynamic contexts. At the same time, they need to be consistent to provide reliable support.

In our research, we have found that a type of generic instructions we call "conventions" can satisfy such requirements. A convention is a selection from among two or more alternatives, where the rule then is agreed upon among participants [21]. Conventions can be seen as a stable, but flexible structure in an ever-changing environment supporting the coordination by functioning as a soft or artificial type of guideline aiding the managers with a set of known ways for dealing with the problems that may arise from complexity.

Leaders must embrace change in Agile organizations. They must be prepared to make fast decisions. They must also secure that the complexity of their production is well coordinated. We assume that the best way to approach a solution is to (a) support the coordination activities by providing flexible guidelines combining multiple system theories, and (b) ensure that these guidelines are harmonized with the development practices used by Agile teams.

3   Research Method

In this section, we describe the research approach and a summary of the steps taken for applying this approach.

3.1   General Research Approach

To develop conventions is such a complex endeavor that it could result in any type of arbitrary solution. To reduce the risk of irrelevant arbitrary solutions and to get a basic scientific foundation, we focused our study on systems thinking models for solving management problems and then extracted candidate conventions that had already been evaluated. We applied a design science approach [30] where we iteratively refined, evaluated and redefined the conventions that were better suited than others to solve the problem of coordinating large Agile projects.

3.2   Summary of Steps Taken for Applying the Research Approach

Step 1. First, we conducted a literature study of the type of problems that were most frequently described when coordinating large software development projects [10][18] [22][32]. We came across generic statements about well-known problems in software development. After a compilation of a large number of presented problems we concluded that: 1) it is often difficult to get an overview of how changes in one sub-

project affects other sub-projects, 2) too many restrictions in the requirement specification makes the whole development process rigid and prevents creative solutions, 3) the larger the project the less flexibility there is, 4) as transaction costs increase with the size of the project, it is necessary to be strict with upholding discipline and thus there is a need for bureaucratic rules that are often not understood.

Step 2. In the second stage we searched for generic solutions to the type of problems that were frequently described as being crucial among the coordination problems. This search was not restricted to software design but rather management principles in general in the areas of system theory, cybernetics, logistics, and chaos theory, e.g. [1][3][5][7][11][16][28].

Step 3. From a large number of well-documented generic solutions to complexity problems we extracted conventions that we estimated as being plausible candidates for being accepted and applied as conventions for coordinating large Agile projects. We specified six basic quality criteria as a basis for extracting the conventions. The method for specifying these quality criteria was based on an analysis of their applicability with regard to systems thinking. In summary, the criteria were: 1) The convention should be applied as a guideline rather than as a control function since control functions are assumed to become too complex to be useful, which is also advocated by Ackoff [1]. We assumed it to be difficult to implement any convention as a strict rule because we found situations where it was not relevant. 2) The convention should be advisory and not mandatory in order to be supportive without producing any new obstacles in the communication processes. We found that to have mandatory conventions could create bureaucratic obstacles as described by Parkinsson [23]. 3) It should be simple to apply. The whole idea of using conventions is to simplify communication concerning difficult problems. Gudykunst [15] also argues for such simplification of communication. Thus, we assumed that complicated instructions for how it could be applied would increase complexity problems rather than reducing them. 4) It should be possible to explain the convention with simple metaphors that can be easily understood and remembered to overcome the communication difficulties as argued by Brockelsby [6] and Snowden and Boone [27]. Software development is a creative endeavor that needs the sharing of understanding rather than scientific correctness of definitions. 5) The convention should support the Agile values, principles and practices. The argument for this is that we aim at proposing conventions that are aligned with the deeply rooted tradition of Agile software development [20]. 6) It should conform to the principles of game theory. To motivate people to use a convention, it should be possible for its users to understand what they could gain from using them. Game theory concludes that people resist actions that may in any way threaten their personal interests [4].

Step 4. We tested the conventions on various examples of problems as described in Step 1. We found that some seemed to be more useful than others according to our quality criteria and these were selected as the core set of candidate conventions that we present in this paper. Beware that the process of discovering and defining useful conventions can be seen as a never-ending process of continuous refinement of useful support structures in the coordination of many Agile projects. This iterative process can probably not be based on any exact form of science because it is always possible for someone to define a new arbitrary convention that may be intuitively perceived as being more useful. Thus, we have concluded that the only way to validate the

usefulness of the conventions is to test them in empirical studies. They can be inspired by generic theories of dealing with complexity and then be validated empirically.

Step 5. Finally, we conducted a pre-study based on semi-structured open-ended interviews to verify the identified research idea and determine future research directions. The objective was to evaluate the usefulness of the candidate conventions. As presented in Table 1, fourteen organizations in Saudi Arabia were chosen based on convenience sampling [25]. Among these, four have multinational presence. The

Table 1. Organizations studied.

	Industry	Employees	Project data	Interviewee
1	Oil & Gas	1,800	Large ERP implementation (SCRUM)	Information technology superintendent
2	Oil & Gas	2,600	Large ERP implementation (SCRUM)	IT Director (CIO)
3	Airline	>30,000	Large ERP implementation (SCRUM)	IT Systems manager
4	Banking & Finance	7000	e-Commerce B2B systems, CRM (Plan-driven and Agile)	Director of project mgmt. office
5	Enterprise software and services	>60,000	CRM, ERP, SCM, etc. (Plan-driven and SCRUM)	Senior project manager
6	Network systems and applications	70,000	MPLS, ATM (Plan-driven and Agile)	Program manager
7	Enterprise software and services	3000	ERP implementation and business process reengineering (SCRUM)	Customer solution manager
8	Real estate, investment, tourism	4000	Large-scale IT security project (Plan-driven and Agile)	Project and IT QA manager
9	Government agency	>2,000	Networking, security, data center and software development (Plan-driven and Agile)	IT infrastructure manager
10	Government agency	>4,000	Web design, security, business intelligent tools etc. (Plan-driven and Agile)	IT program manager
11	Business system integration	>700	Security services, Data centre services, cloud computing etc. (Plan-driven and Agile)	IT project manager
12	Business system integration	>50,000	Large-scale IT transformation (Plan-driven and Agile)	Senior IT consultant and project manager
13	Airline	>1000	Large ERP implementation (Plan-driven and Agile)	IT systems manager
14	Banking & Finance	2,000	e-Commerce B2B systems, CRM (Plan-driven and Agile)	IT services manager

others represent an ERP solution provider and IT-departments within the banking, airline, oil and gas, and public sectors, respectively. The software projects within these organizations either develop software for external customers like the case with the multinational companies and the ERP solution providers, or develop software for their internal corporate users. The size of the organizations ranges from 700 to 70,000 employees, and they are considered leaders in their industries.

Fourteen interviewees, one from each organization, were selected based on three criteria: (1) their job roles and responsibilities (senior managers) (2) years of experience in IT project management (at least 7 years), and (3) an estimation of their adoption and experience of Agile development. All of them were familiar with and had practical experience of the Agile methods.

We created a questionnaire. The questionnaire was open-ended and semi-structured. It focused on finding out (1) whether the conventions were recognized in the industry today, and (2) their status within the organizations studied.

To cover the conventions and the evaluation criteria of this study, 50 questions were created. Due to space restrictions, we cannot list them all. However, the questions that were asked followed a somewhat uniform pattern. The pattern was: (1) Do you use this convention? (2) If no, please describe why? (3) If yes, please (a) describe why, (b) describe how, and (c) provide examples. (4) Are there any benefits you find with this convention? (5) Can the convention be improved? If yes/no, please motivate why/how? (6) Are there any additional comments that you would like to add? The questions are also further described in Chapter 5.

In summary, each convention was briefly described to the interviewee. Then the interviewee was asked if he or she agrees with the convention and whether it is used. If there were signs that the interviewee had experience of the convention, then the discussion kept on going. Otherwise the convention was considered irrelevant and the interviewee was asked to describe why they had not employed any similar approaches as was described in the convention.

4 Candidate Conventions

This section describes the eight conventions that were extracted and synthesized from scientific publications. The conventions are listed and briefly described in the sections 4.1-4.8 below.

4.1 Speak Their Language

Argyris [3] has shown that a major obstacle when dealing with collaboration in complex contexts is the emotional content of various types of communication. Hence, the most effective way to secure that the communication works well when several teams are coordinated is to use their language and also give specific feedback to the teams on how they describe their work, their needs and their progress [3]. At a later stage, communication standards can be developed for how teams should communicate

with each other, but if these are prematurely introduced they create more confusion than they solve [15].

4.2 Create a Culture of Public Benchmarking

One of the most efficient methods for sharing knowledge is to compare the performance between teams. However, if managers do not give feedback, criticism and appreciation in a similar way to various teams it is difficult to create a culture of fair, open communication [7]. In order for teams to adjust descriptions of their work according to how other teams describe their work, it is necessary to develop a continuous dialogue around comparisons between teams. A specific version of this called "Peer Sites" has been successfully tested where one software development site gives a personalized response to another development site [9].

4.3 Motivate from Personal Experience

Managers who cannot argue for their motivation by providing references to practical experience may risk the communication trap of having subordinates not understanding them [31]. This is especially important when there are few fixed routines, which puts a high pressure on people's ability to accept abstract ideas. To provide rational and consistent arguments may also be difficult when several theories or perspectives are discussed. From one perspective, the arguments may be right but seen from another they may be wrong. In such cases, using examples will clarify the ideas. Hence, the manager who motivates their arguments combined with real, concrete examples is more likely to be understood than the one who uses abstract theories.

4.4 Include Subordinates in Meetings

In all large organizations there are power games [1]. One aspect of power games is that people create territories within the organization impeding effective communication. Hence, to prevent these kinds of situations, representatives from various hierarchical levels should be included in meetings [1]. Meetings between management and team leaders should always include at least one member of the team and it should preferably be a different member at each meeting. This empowers each team member to communicate his/her view of the project and motivates everyone to be part of the decision process. By always trying to include three hierarchical levels in meetings secures that relevant aspects is moving between all levels of the organization. In the proposed system model of "Interactive Planning", Ackoff [1] demonstrates how a similar approach secures that the communication flows more freely among the members of a large project.

4.5 Combine Various Modeling Methods

Ever since the famous book about Parkinsson's Law of Bureaucracy [23], the dangers of following a specific model too rigidly has been proven over and over again. The solution is to have a flexible attitude towards models and use them when, and in whatever combination of models, needed and using the models as support tools rather than governing systems [11]. Hence, managers should be skilled in drawing "Rich Pictures" [8] which provide models of the problem that can easily be explained to laymen and make them aware of the various perspectives among stakeholders in a complex project. A manager can apply several different perspectives at the same time and for each perspective make conceptual models. When a number of conceptual models have been presented it is possible to compare all the models with the software development situation and draw conclusions based on more than one perspective.

4.6 Use Global Definitions

Using different definitions on various organizational levels will cause confusion. In his works with "Viable System Models", Beer [5] became famous for his introduction of cybernetics. According to his model, the communication processes between all levels of the organization could be recursively described, i.e. the same communication protocols or definitions that are necessary among teams on a lower level are also necessary on higher levels. Hence, by using recursive descriptions support the global communication in large projects because similar communication protocols are used on all levels of the project.

4.7 Accept Chaos As a Driver of Development

Leaders who try to impose order in a complex context will fail [27]. A manager should accept a certain amount of chaos in the development process as long as this does not inflict on the basic goals of the project [28]. To determine an acceptable degree of chaos, managers should be familiar with complexity theory. Stacey [28] claims that in large projects the most highly valued competence of managers is to be able to deal with relationships, dynamism and unpredictability. The managers should not try to control everything but instead use this competence to shift leadership style accordingly.

4.8 Centralize Critical Rules

Using a strict "management by objective" approach in a complex context will likely constrain the productivity of teams [19]. Hence, formalizing goals and constraints as generic rules or principles that can be implemented in whatever ways the teams find appropriate will provide a softer direction enabling team creativity and productivity.

The history of complex systems have many examples of a paradox saying that that managers can be free to decentralize decision making if they have been cautious

enough to centralize the critical rules. Thomas [29] describes the results from several studies of how productivity rises once there is a sound and stable foundation allowing the employees to design their own work. Another analog example, illustrates how cities can be made to be self-organizing as long as there is an understanding of the critical thresholds of the city [13].

5 Results

In this section, we present a summary of the results from the 14 interviews. In general, it can be stated that most conventions were aligned with the interviewees' views of how teams should be coordinated. All fourteen interviewees demonstrated that they understood the conventions, also by providing practical examples of their usefulness in terms of both pros and cons in the context of their organizations.

The evaluation of the conventions was carried out by using different evaluation criteria than those that were used to extract candidate conventions. The method to extract the most plausible among the candidate conventions was based on a literature study where we found generic descriptions of types of behavior that was documented to work well in large projects. To evaluate the usefulness of the proposed conventions an entirely different method was used. We assumed that it would not be feasible to interview managers concerning to what extent their behavior could be explained by various systems thinking models. Instead we applied a simple and straightforward method based on the managers' opinions of the applicability of our description of the conventions. In this way, we could collect empirical evidence that would indicate the level of usefulness of the proposed conventions. Asking the following questions to the interviewees accumulated these opinions of the conventions:

- Do you use any approach or combination of approaches that are similar to the described convention?
- If yes:
  o Can you provide examples? This was taken as an indication of the usefulness of the convention.
  o Can you motivate why it works or not works? The response indicated to what extent the convention could be easily communicated.
- If not, would you be interested in testing the convention? A positive answer was taken as an indication of its potential use. A negative answer was taken as an indication of the conventions as not being useful.
- Can you exemplify possible benefits of using the convention? A positive answer was interpreted as an indication of the convention as being useful. A negative answer was taken an indication of the convention as not being useful.
- Can you exemplify any negative effects of applying the convention? A positive answer was an indication of it not being useful or an understanding of the limitations of the convention. A negative answer was an indication of its usefulness.

When interpreting the answers from the managers we made a clear distinction between what can be considered opinions of the interviewed managers and what can be considered as being based on factual experiences. In all cases where the managers

could provide examples, we concluded this data as being more valid than voiced opinions without examples. A summary of the results of the evaluation of each convention is described in the sections 5.1-5.8 below.

5.1 Speak Their Language

Nearly all interviewees shared a similar view that speaking their teams' language implies connecting people to people, and teams to teams not merely a process output to a process input. Ten out of 14 interviewees have explicitly confirmed that continually adjusting the communication will encourage teams' congruence and collaboration. In this regard, it was mentioned: "I spend times with different teams, speak their language, understand how they deliver their work and also try to make them understand how other teams apprehend their work and how they impact other teams when they deliver something." Eight out of 14 interviewees think that the convention would help managers to realize how their teams will deliver as promised. Twelve out of 14 interviewees mentioned that they specifically think that the convention can prevent communication conflicts from escalating. Hence, the convention has a definite acceptance and is likely to be used to secure that the communication works well.

5.2 Create a Culture of Public Benchmarking

Not all interviewees shared a similar view about the convention's importance. Five out of 14 interviewees think that it is a very sensitive topic, which can easily drive teams to oppose each other. Two reasons were given: four have failed to implement the convention due to cultural considerations while one believes that the convention is of low priority. The latter indicated that it is inappropriate to compare the teams' presentations because it will be a waste of time and effort to ask other teams to adjust their work accordingly. As he said: "In my view, this could result in an ambition among other teams to re-implement or to add more tasks to comply with the best team… we are talking about an increase in project duration and an increase in cost even if we will get a better quality to some extent." On the contrary, he suggested: "It is better to bring the teams' leaders together, and have them agree on standards and procedures. If the teams follow the same standard and procedures, then they can more easily share knowledge about their results." However, 8 out of 14 interviewees mentioned that benchmarking could help in raising performance standards by enabling knowledge to be shared and reused. Among those it was, for instance, mentioned: "Creating such culture… increases the good competition between the teams, because one team's good performance is an example for the other teams. It enhances the quality of all teams. So, we always raise the standards or the bar higher by showing the great performance of one team as an example for the others and, if there is any great job experience, then we always promote the dissemination of descriptions of this and share all the documents publicly". Hence, the convention has a partial acceptance, as it is less likely to be used to enhance continuous dialogue between teams.

5.3 Motivate From Personal Experience

Nearly all interviewees shared a similar view that the use of bundled experiences would help both the managers and teams to overcome communication bottlenecks. However, 9 of out 14 interviewees indicated that the arguments must be carefully composed to achieve certain needs and to not impose any restraints on the teams' own inspiration. Twelve out of 14 interviewees indicated that the convention could enhance better communication between the managers and teams. Among those it was mentioned: "With the accumulated experience that one has, it will help a lot in discussions, in meetings, in highlighting issues, in reaching to agreements, etc. Especially, when you quote, from your past personal experience, some other companies that did an implementation of the same type of system that you are trying to implement…. this will help others to understand that they can achieve the same things." Another responded: "I believe in managing by examples, so if I have a situation where I am arguing with a team member or a team leader, then clarifying by giving some examples is a good idea to achieve a common understanding… The project managers should also be open to other ideas until there is a consensus about which solution should be taken". Hence, the convention has a definite acceptance, as it is likely to be used to enhance better communication with teams.

5.4 Include Sub-ordinates in Meetings

All interviewees acknowledged the need of connecting people to people regardless to their positions and responsibilities, which in return would foster their teams' development and learning. In their comments of what benefits they can get, the following motivations were given: "It is a good technique especially to motivate people and to develop people further"; "It is one of the very efficient tools to develop people... and very effective way of decision making"; "You will be surprized how team members can present something that gives you a direction that you did not even think practically about at that time... taking feedback is very important... it will be like a 360 view of any subject"; "[As a developer] listening to how the strategy was brainstormed, how the decisions were made, and how the challenges and conflicts were resolved was like an eye opener for me at that time". Exceptions to that, 5 out of 14 mentioned that managers should be careful when sending subordinates to critical meetings, such as meetings involving financial discussions or some customer executive meetings. Hence, the convention has a definite acceptance among the interviewees, as it is likely to be used to promote communication, team development and learning.

5.5 Combine Various Modeling Methods

All interviewees shared a similar view that in complex projects, models are used to address, understand and help solving problems and not merely to describe processes and standards to follow. As one said: "In software development projects, flexibility is essential and very important in managing projects… So, it is advisable to use different

models". Another interviewee stated: "Each project has its unique category and level of complexity, so the project manager should be able to employ models that suites the project, in whatever combination he thinks will work well". Ten out of 14 interviewees indicated that the convention could help in building stronger teams that deliver better quality. In the same vein, 5 out of 14 interviewees indicated that the convention could help managing projects in much faster ways due to less formality. Among those it was mentioned: "Combining different models and methods when managing projects will definitely help project managers to accomplish critical goals such as time-to-market". Hence, the convention has a definite acceptance, as it is likely to be used to support project governance by improved communication.

5.6 Use Global Definitions

All interviewees shared similar opinion that common definitions across the project organization would provide high synergy among teams and maintain consistency in communication, documentation, and reporting. Generally, their adoption of the convention is primarily to reduce confusion and eliminate potential conflicts that may occur due to misinterpretation especially in complex projects. Nine out of 14 interviewees indicated that using global definitions could be a timesaving and efficient way for project success. In this regard, it was mentioned that: "The convention can bring more advantages including seamless communication, avoid misinterpretation and conflicts, and avoid risk which becomes more important when dealing with offshore teams"; "Having a unified terminology or terms will make everybody understand each other and it plays a critical role for creating environments for clear communication". Hence, the convention has a definite acceptance, as it is likely to be used to support mutual understanding across the project community.

5.7 Accept Chaos As a Driver For Development

Nearly all interviewees consider some chaos to be effective in many ways. For instance, a) ten out of 14 interviewees consider it a driver for timely project development and delivery, as it was stated: "Chaos is sometimes important to provide control over the project cycle itself, otherwise many projects might go in no end to be completed" and b) five out of 14 interviewees considered it as an enabler for teams to thrive and assume higher responsibilities. However, three interviewees mentioned that accepting chaos must be accompanied with careful attention, as motivated by one of them: "It should not change the scope of work, it should not change the time frame, it should not affect the budget, and it should not do a drastic change to the project model or to the project standards. I can accept 10-15% percent change here and there whenever it is required." Hence, the convention has a definite acceptance, as it is likely to be used to drive project development forward as a way to gain control over the project cycle and as an enabler for communication and team development.

5.8 Centralize Critical Rules

Everyone but two have accepted the convention. The latter two favour "management by objectives" as a support for timely delivery of the project and securing productivity. The other interviewees, on the other hand, share similar views on accepting a critical set of rules instead of strict objectives and systems as a driver of productivity. Among those, one indicated that in complex projects he prefers to give "the minimum set of rules and a lot of flexibility to the teams to decide how they would like to manage their work". He also pointed out that managers must randomly check the capabilities of their teams and empower them to make decisions. Another interviewee mentioned "I don't agree much with strict management by objectives. I believe that you need to draw the borders for them and let them play or implement the way they want within these borders." Hence, the convention has a definite acceptance, as it is likely to be used to empower the teams to decide how to best accomplish their tasks and goals, and thereby increase the productivity of the project as a whole.

6 Discussion

In this section, we briefly discuss the results of the evaluation of the conventions. Generally, all of the conventions were considered to be applicable in the interviewees' organizations. We argue that this high level of applicability is due to the correspondence between the conventions and the principles of complex adaptive systems (CAS) as described in [2], where it is shown that the CAS principles self-organization, emergence, interdependence and coevolution also exist in most well functioning Agile organizations. In this regard, as we have also evaluated and ensured that the conventions are aligned with the Agile values, principles and practices, it is also worth noting that our findings also support the findings of Pelrine [24], in his suggestion that complexity science provides a theoretical basis for Agile. Hence, by treating software development as a complex endeavor, rather than a linear, will help managers to master large Agile projects.

Finally, we have often been asked why we restrict the conventions to being suitable for coordinating Agile projects instead of claiming that the conventions are good for coordinating projects in general. Our answer to such questions is that the conventions may very well be applicable to any large project where there is a need for an Agile type of flexibility within a strict framework, but we have intentionally selected an instance of this problem, i.e. large Agile projects, where there is a strong polarity between the need for flexibility on one hand, and a need of strict correctness on the other hand. We have shown how it can be possible to follow a combination of scientific models while at the same time promoting an Agile type of flexibility.

7 Concluding Remarks and Future Research Directions

This research associates systems thinking with the management of large Agile teams. It suggests that the managers' ability to master complexity can be improved if they

adopt a set of proposed conventions. The conventions facilitate a multi-methodological system approach to coordinate teams by increasing communication and interaction. A pre-study based on 14 interviews was conducted, the results of which indicated a high degree of usefulness of the proposed conventions. Hence, the results imply that a set of conventions can potentially facilitate coordination by serving as a supportive context enabling managers to apply various system thinking models simultaneously, and thereby help them to focus more on the broad responsibility of leading the project as a whole.

There are different approaches to managing an organization as a complex adaptive system, e.g. "Learning Organizations" [26], Cynefin framework [27] and "Human System Dynamics" [12]. We view each of these approaches as appropriate guides to management of Agile organizations. However, it would be highly valuable to compare the conventions presented here with existing guidelines in these approaches. For instance, a structured analysis of the guidelines defined for the different domains in the Cynefin Framework would contribute to further knowledge about the conventions and their applicability.

This work is still at an early stage, but we aim at continuing our efforts in investigating the potential effects as recognised in the pre-study at a larger scale. The overarching target is to contribute to improving the communication, cohesion, efficiency and performance of large Agile projects. Nevertheless, to reach concrete results, we intend to conduct further empirical investigations, e.g. by case studies. We also assume that there will be continuous modifications of the conventions to ensure they meet the needs of managers of large Agile projects.

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