Agile and Traditional Project Management: Comparing Agile, Traditional and Hybrid Project Management Practices

A research study of project management professionals in Germany

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Abstract

The study researches the use of the hybrid project management approach in practice. The challenges of both agile and traditional project management models represented by 15 established project management Critical Success Factors (CSF) were used to examine the differences between traditional, agile and hybrid project management practices. Although other studies have investigated the CSF in traditional and agile project management, this study is the first to review 15 CSF for hybrid project management.

The research takes a quantitative approach using a survey as the research method. The primary data for the present study were collected in Germany by an online survey. These primary data were collected with the participation of project management professionals from the German Chapters of the Project Management Institute (PMI). In the subsequent analysis of the online survey data, 15 hypotheses for hybrid project management were formulated, in addition to the existing body of knowledge of traditional and agile project management.

Project management models make change possible where simple, complicated and complex kinds of project management are required and academia benefits from this work through its insight into the increased need for flexibility in this context. This research shows that neither traditional project management nor agile project management is wholly similar to hybrid project management. The main finding of this research is that its similarity depends on the CSF. As a research outcome, the guiding principles have been formulated for showing which situations merit hybrid project management. The research also benefits practitioners, since it will guide project managers who are not sure when and where to use a certain project management paradigm. As an outcome, the research implies that project managers will better understand why and in which situation traditional approaches should be chosen, and why and when agile or hybrid project management approaches should be preferred.

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Glossary of terms

A

Artifact: A tangible by-product produced during product development. The product backlog, sprint backlog, and potentially shippable product increment are examples of Scrum artifacts.

C

Critical Success Factors (CSF): The decisive factors for the success of a project are described in terms of these factors

D

Daily Scrum: A brief, daily collaboration meeting in which teams review progress from the previous day, declare intentions for the current day, and highlight any obstacles encountered or anticipated; also known as daily stand-up.

I

Increment: A functional, tested, and accepted deliverable that is a subset of the overall project outcome.

Man-day (MD): a day regarded as the number of hours of work that one person can complete in a day, also-called person-day.

P

Phase-Gate: A phase-gate process (also referred to as the Waterfall process), is a project management approach in which the activity (e.g., the development of a new product or software) is divided into distinct stages or phases, separated by distinct decision points (known as "gates").

Product Backlog: An ordered list of user-centric requirements that a team maintains for a product.

Product Owner: A person responsible for maximizing the value of a product and ultimately responsible and accountable for the end product that is built.

Project Management Life Cycle (PMLC): From the preparation to the final completion of the project, the project lifecycle is the sum of all the phases of a project.

Project Success Criteria (PSC): Describes the criteria which determine the success of a project

S

Scrum: An agile framework for developing and sustaining complex products, with specific roles, events, and artifacts.

Scrum Master: The coach of the development team and process owner in the Scrum framework.

Scrum Team: Describes the combination of development team, scrum master, and process owner used in Scrum.

Sprint: Describes a timeboxed iteration in Scrum.

Sprint Backlog: A list of work items identified by the Scrum team to be completed during the Scrum sprint.

Sprint Planning: A collaborative event in Scrum in which the scrum team plans the work for the current sprint.

Sprint Retrospective: A regularly recurring workshop in which participants explore their work and results in order to improve both process and product.

T

Time-boxed: A fixed period of time.

V

VUCA: volatility, uncertainty, complexity and ambiguity

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1. Introduction

This research looks at the recent trend among project professionals to combine traditional and agile project management practices (so-called ‘hybrid project management’). The key differentiator between traditional and agile project management is the way in which project management processes are managed. In traditional project management, project managers have to use defined stages in which each stage has its own controls, which are also referred to as “phase-gates”. Traditional project management uses phase-gates in every project phase because the traditional project management model (also-called the ‘Waterfall model’) is based on the notion that a linear process model is organised in successive project phases. What this means is that at each step the project manager has to obtain permission (e.g. via a Steering Committee) before s/he is allowed to move on to the next project management phase. The set-up of the project is defined at its initiation and cannot be altered flexibly once the project has been officially started; this has the advantage of giving large corporations a high level of planning reliability. The recently more popular agile approach, in contrast, has altered not only the scope but also the priorities every 2 to 6 weeks. This results in less bureaucracy and at the same time increases the ability of companies to adapt quickly to change. In addition, it minimizes the risk of developing a potentially “wrong” product which does not fulfil customer expectations. Large corporations, however, require planning reliability and multinational companies in particular struggle to balance the need for planning reliability with flexible reactions to a changing environment or to the development of products whose requirements are not yet fully identified. Therefore, during the last 3-5 years, practitioners have begun experimentally to combine the traditional and the agile project management approaches (=hybrid project management), a step which academics have not so far studied in depth. Hence the motivation for the present research.

A growing number of studies (e.g. Helena 2017) show that especially in software development there is no "black or white", no need to choose either traditional or agile project management. Recent studies reveal that **76.8% of all project managers combine different project management approaches and tools** (Helena, 2017). Having chosen a development approach, most companies strive to improve productivity and cost (71%). This means that only a minority use their project management model in its pure form and most apply changes to existing models leading to the hybrid use of multiple project management frameworks and their tools. However not many studies have been carried out on this increasing phenomenon. To find out more with regard to this phenomenon is important as academia has not yet researched hybrid project management from a Critical Success Factors (CSF) perspective. This is very interesting for two reason: first, practitioners have no guidance when to use which project management approach. Secondly project management associations introduce hybrid project management in their curriculum but literally nothing is known about hybrid project management Critical Success Factors (CSF), which will give both academia and project professionals a better understanding when to use which approach.

For this reason, the research set out to learn more about this trend and to identify the challenges and benefits in traditional, agile and hybrid project management. *It researches the status quo of project management approaches and how and how far a hybrid project management approach is used in practice. Furthermore, it is researching differences in* ***Critical Success Factors (CSF) of hybrid project management*** *in addition to the already established factors for traditional and agile project management.*

Hence, the **theoretical foundation** of this research is

1. The quite well-established Project Management Success Criteria (PSC) and project management Critical Success Factors (CSF)
2. Contingency theory in form of the Cynefin framework

The research question and objectives below are subdivided as follows:

1.1 Research aim and objectives

The main research question to be addressed in this dissertation is:

Are there any differences in the critical success factors associated with traditional, agile and hybrid project management?

Research objective 1:

To what degree are traditional and agile project management practices used?
How are these approaches used and combined?
What are the existing challenges in project management with the agile and traditional project management approaches?

Research objective 2:

Which challenges are better addressed by traditional, and which are better addressed by agile project management?
This aims to determine if there are differences between the two approaches and to identify existing challenges highlighted from the traditional and agile project management perspectives.

Research objective 3:

Is there any significant difference in the Critical Success Factors (CSF) between the Traditional, Agile and Hybrid project management approaches?
By using the defined CSF, this research question investigates the difference in these CSF by comparing traditional, agile and hybrid project management approaches.

1.2 Contribution to theory, practice and the use of methodology

For practitioners it is relevant because in current project management the approaches of traditional and agile project management, though good project management practices in themselves, are often used in isolation and ideological dispute between the two camps seem to be irreconcilable. For academia it is important to acknowledge and incorporate the increased need in good management practice and the related theory both for flexibility for the sake of change in project management models, and planning security.

This study found that hybrid project management is neither entirely akin to traditional project management nor to agile project management. Its similarity depends on the respective CSF: this is the main finding of the research. As a research outcome, the study formulates the guiding principles for choosing the situations which merit hybrid project management. The research also benefits practitioners, since it guides project managers who are not sure when and where to use some project management paradigm. One of its outcomes is the chance for project managers to better understand why and when traditional approaches should be chosen, and why and when agile or hybrid project management approaches should be preferred. This research into project management analyses the recent hybrid project management phenomena from an objectivist stance, based on a postpositivist epistemological position supported by an online survey. With this in mind, the outline of thesis is presented in the next section.

1.3 Outline of the thesis

This dissertation consists of ten chapters. Chapter One gives an introduction to the DBA thesis, providing background information and more recent developments in hybrid project management. It also provides the basis of the study and an overview of the research project as a whole. It also outlines the rationale for the project, including the research aim and objectives. Chapter Two, systematically compares traditional and agile project management, to clarify the differences between them. First, it looks at the development of waterfall models and next at agile project management.

Chapter Three gives the scientific basis for Project Success Criteria (PSC) and Critical Success Factors (CSF) in project management. The main focus of this study is on the Critical Success Factors (CSF) in projects; these, at the heart of the study, reveal the differences between the three approaches of traditional, agile and hybrid project management. The two most clearly contrasted project management approaches precede a description of what is called the project management “magic triangle” (a.k.a. ‘iron triangle’); its major features and its assumptions appear following the well-established model of constraints within project management. Next comes an introduction to contingency theory in form of the Cynefin framework as the underlying theoretical concept for this dissertation. Hybrid project management, combining traditional and agile project management approaches is then introduced, leading to the concept of context-driven project management within the Cynefin framework. In order to explain and justify why and when which approach should be used, the thesis adds Snowdon’s liminal Cynefin framework to its theoretical foundation.

Chapter Four introduces the concept of hybrid project management. The literature review section closes by deducing the variants of a hybrid model. It defines this project management approach and its varieties of integration. The following section explains the selection of hybrid models and then reviews the latest academic discussions of hybrid project management.

Chapter Five defines the research problem. After stating the research aim and questions, the chapter defines the hypotheses for this research.

Chapter Six gives the reader insights into the research methodology, justifies the approach chosen and discusses the research contribution to theory.

Chapter Seven is the main study chapter. It introduces the questionnaire, reviews and justifies the questions used, reviews the demography of the survey, and provides answers and details for research questions 1 and 2. It also introduces the reader to the detailed hypotheses for research question 3.

Chapter Eight discusses findings concerning the hypotheses using the survey data and answers research question 3. In this chapter all 15 factors are discussed, comparing traditional and agile with hybrid project management.

Chapter Nine uses the results of Chapter Eight and analyses the data further by determining differences in the interdependency of the CSFs, based on correlations of previously introduced project management approaches.

This research concludes in Chapter Ten, which discusses the contribution and limitations of this research, and makes recommendations for future studies.

Modern project management embraces numerous models, overviewed in the following section. Before the project management approaches are compared, it may be helpful to review both models in more detail.

2. Project Management Models

2.1 Traditional Project Management

2.1.1 Traditional Waterfall Model

In Waterfall models, each phase has a pre-determined start point and end point and precisely defined deliverables. At certain milestones and at the end of every phase, the project planning documents are approved, normally by a Project Management Office (PMO).

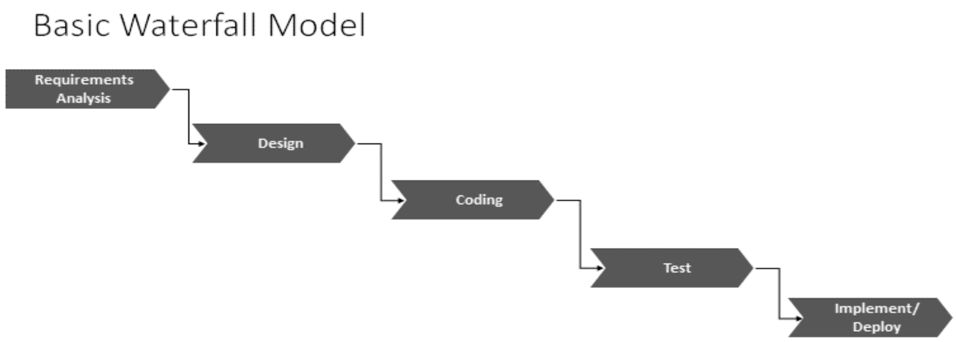


Figure 2.1 Basic Waterfall Model
Source: adapted from Asnawi (2012)

In business practice, this is traditionally a widespread process model which has many variants (adapted from Bryde (2003), Asnawi (2012), Liu (2013)).

In the classic Waterfall model, each phase is required to define exactly *what* is to be achieved (requirement), sometimes complemented by describing *how* it can be achieved (design). For the project to deliver each of the achievements (in project terms often called ‘deliverables’) documents have to be created to describe this exact achievement. In technical projects this is called specification. In principle, the next phase cannot be commenced until the previous phase has been completed and the so-called “state-gate” or “phase-gate” has been passed. The phase results always serve as binding guidelines for the next phase, which makes the planning less flexible.

For instance, in the requirement phase a document is created which lists all the customer's requirements. The name "Waterfall" comes from the frequently used graphical representation of the project phases organised in sequence (Asnawi, 2012). The model is shown in Figure 2.1.

If a phase cannot be completed successfully, for example, because it turns out in the implementation phase that some specifications cannot be realized as planned, the project must return to one of the preceding phases. Due to the clear and simple structure of the project's progress from phase to phase, the Waterfall model still enjoys great popularity today. It reduces the danger of being unable to progress because of too many parallel activities in the wrong order (Wysocki, 2019).
Due to the absolute pre-requisite that a phase must first be completed before the next phase can begin, the quality of the project objective is ensured (PMI, 2017). However, it is important for quality to be clearly defined and reviewed at the end of each phase because it determines what can be achieved in the next one.
Such a procedure is said to run on the **stage-gate** principle (Liu, 2013): In this case, the activities to perform and the results to achieve are precisely defined for each phase. At the end of a phase, i.e. at the "gate" to the next phase, the project must halt until the project task and results of this phase are checked. Only if the outcome of the project work is sufficient can the project proceed to the next phase. These quality controls after each project phase are also-called quality gates. In the classic Waterfall model, quality gates are not repeated. This means that overlooking problems of quality at any quality gate makes it highly likely that they will persist in the finished product. Although the classic Waterfall model is still very popular, due to its sequential handling, one of its biggest disadvantages is that a quality issue becomes apparent only when a gate is reached (O'Sheedy, 2012, Alqahtani, 2014). In addition, the requirements are set at the beginning of a project. At this point, the project is not always completely manageable (O'Sheedy, 2012). If changes are needed, they must be incorporated via so-called change requests. However, change requests can increase the time and budget of a project. If there are many change requests, the focus of the original objective may be lost (Grushka-Cockayne et al., 2015).

In today's world, driven by technology, data availability and consequently quicker decision making, swift adaptation to change is required much more often than it was 20 years ago. The traditional Waterfall model therefore is considered to be more inflexible in accommodating changes. The focus is entirely on the process and ignores people (McManus, 2007; Cockburn and Highsmith, 2001), which in the world of today has also become an increasingly important factor in managing projects successfully.

What makes the model popular is its control aspect, the clear link between performance and costs making a "magic triangle" (Atkinson, 1999, Munassar and Govardhan, 2010), which gives management the impression of identifying and managing project risks by embedding formalities in the project management process.

To summarize, the traditional Waterfall model uses the purest form of a linear-sequential process model. It originated in manufacturing where highly formalized processes are required (Royce, 1987), because changes to design become exorbitantly expensive. For this reason, the Waterfall approach requires detailed requirements and specifications before any implementation starts (Asnawi 2012, Lozo and Jovanovic (2012).

2.1.2 V-shaped Model

Originally developed by Jensen & Tonies (1979), the V-Model also makes use of successive project phases. It was named after the arrangement of the individual project phases, as shown in Figure 2.2. On the left-hand branch of the V, the project object to be realized is specified further and further from the rough draft to the detailed draft. After implementing the specified project item, the right-hand branch of the V is traversed from the bottom up. First all the components are tested, then they are integrated into the entire system or a subsystem and finally tested in this new integration. At the end, the customer requirements are validated so long as customer accepts the specifications.

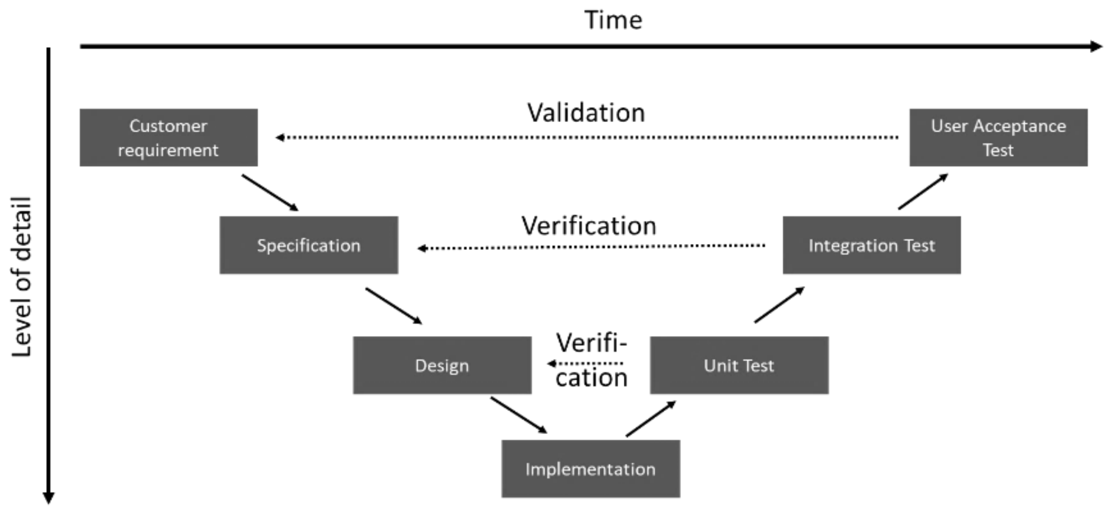


Figure 2.2 V-shaped Model
adapted from Tatikonda et al. (2002), p.178

Each specification and design phase of the left-hand branch is verified in the form of corresponding tests. This structure promotes the idea of quality and integrates it firmly into the model. Everything that has been specified and for which a design draft has been created must later be verified as part of the verification and validation. Since the two latter terms are important in the project business and are sometimes changed, they are defined here briefly (as in Timinger 2017).

Verification is the clear demonstration (usually by measurement) that a specific requirement (of the specifications) is fulfilled. The verification answers the question of whether it has been implemented correctly (in terms of the requirement). Validation confirms that the customer's request documented in the specifications has been fulfilled (Jensen & Tonies 1979): it answers the question of whether the right thing was developed for the customer. In the V-model, the individual phases are arranged in a sequence.

The benefits of the V-model are the self-explanatory process model design, the clear structure and breakdown of activities and its attention to quality through mandatory verification and validation (Timinger 2017). Hence this project model is used in industries where product safety is of particular importance, such as the pharma or aerospace industries. The V-model is widely used because the model's built-in verification and validation can provide complete evidence that the requirements have been met (Helena, 2017).

On the downside, project results are evaluated only at the end; early feedback to developers and customers is not provided (Munassar and Govardhan, 2010).

Critics have also raised the objection that the V-shape model "depicts a linear and controlled process, and implicitly assumes that the customer will understand the content and activities of all software development tasks and subtasks (even the most detailed). The V-shaped model is therefore "unlikely to provide an accurate description of software development practice" (Rowen 1990, in Tatikonda et al. (2002) p. 178). In addition, critics have accused this model of being documentation-heavy and maybe too bureaucratic for small projects (Rüping, 2003).

2.1.3 Spiral Model

The Spiral model enhances testing by providing many test iterations, reducing the risk of creating a product which is inconsistent. The spiral model is different from the Waterfall model in that it introduces an iterative approach that works in a series of small sub-projects or iterations via prototyping, which distinguishes the Spiral Model from the traditional method and the V-Model (Munassar and Govardhan, 2010).

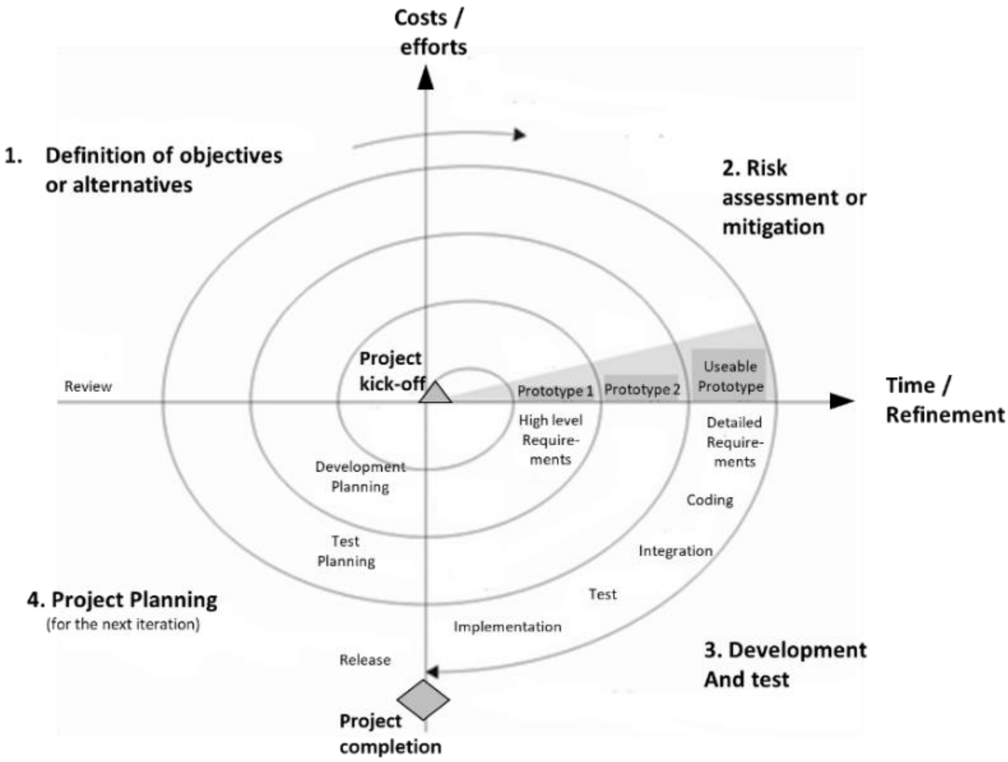


Figure 2.3: Spiral Model
adapted from Boehm (1986)

The best-known example of a repetitive process model is the spiral model shown in Figure 2.3 above. Each iteration (repetition) is used to identify and refine requirements, clarify goals, and enhance design from requirements from coarse design thru detail design. With the spiral model, the project start is shown in the centre. In several recurring iterations, the goals and requirements are identified, alternative solutions evaluated, the risks to be minimised identified and the requirements implemented and tested, before and the next iteration is finally planned. From iteration to iteration, the project item becomes more concrete each time an iteration is made. The project can be completed when the last iteration makes the finished product available. In planning the repetition loops, care should be taken that at the end of each loop, there is a viable and analysable result (Timinger 2017). Each partial result must provide suitable insights for the planning and execution of the next loop pass. Otherwise, the overall project result will lack concretisation and stability.

The benefits of the structured handling of unstable requirements via these iterations are the consciously step-by-step concretisation of the project deliverables and fulfilment of its objectives and the fact that software is first produced early in the software life cycle, i.e. a new prototype is obtained with every iteration (Rather and Bhatnagar, 2015). On the downside is the risk of additional project efforts if corrections are needed to later increments. The conscious step-by-step procedure may also invite changes which will delay the completion of the project. In addition, Munassar and Govardhan (2010) point out that the risk analysis requires special expertise and that like the V-model it is not suitable for smaller projects.

Due to its repetitive character and emphasis on the gradual detailing of the project results, the spiral model resembles the well-known agile procedure model Scrum, which is considered in Section 2.2.1. However, one should note here that agility is not achieved by going through processes, but through a different *attitude* in many management areas from traditional thinking patterns (Rothman and Kilby, 2019).

2.1.4 Overview of the development of Waterfall models over time and rapid prototyping

In rapid prototyping the consumer is made aware of all the developments, which is a clear advantage not possessed by the traditional Waterfall model, which does not often allow the consumer of a product to be sufficiently involved at the product development stage; s/he is often presented with the final product only at the end of the traditional cycle (Mackay et al. 2000). This leads to situations where the product may not be developed according to the customer's requirements. Rapid prototyping addresses this problem systematically by involving the customer as an integrative part of the model (Asnawi 2012, Boehm 1986).

However, because complex requirements in product development, for instance, or software development are not completely definable in advance, the need for flexibility increases. To meet this need, agile methods were developed. Incremental approaches lead to better results in cases where a full functional specification cannot be determined upfront (Mehan, 2012); this is covered in the next section.

A summary of the various Waterfall Models and their development over time can be seen in Figure 2.4:

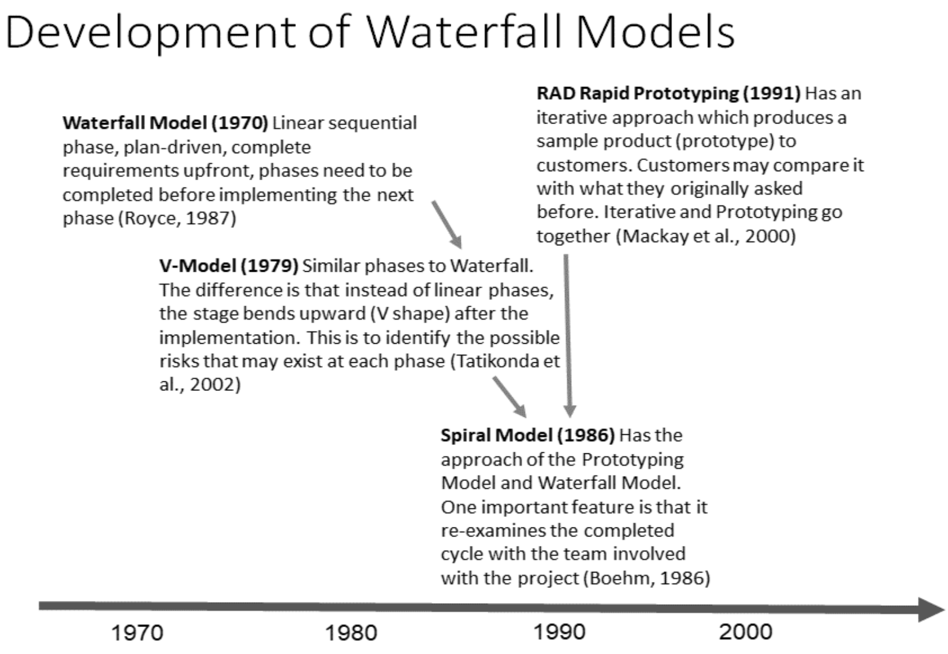


Figure 2.4: Development of Waterfall Models adapted from Asnawi (2012), Bryde (2003)

2.2 Agile Project Management

Agile software development is the generic term for the use of agility in software development, and also in product development and other non-IT projects (Timinger, 2017). It is now widely used and research shows its positive impact, which has allowed projects to be completed more successfully (Serrador and Pinto, 2015). Agile is characterized by self-organising teams, as well as an iterative and incremental approach to incorporating new requirements (Asnawi, 2012). It seeks to manage with little bureaucracy and few rules and can thus adapt quickly to change, minimizing the risk of errors (Alqahtani, 2014). Hence, agile project management is a countermovement to traditional project management processes, which are often considered heavy and bureaucratic (Wysocki, 2019).

A clear trend towards the of use agile methods has emerged: VersionOne carried out an annual Agile Survey and found in 2013 that as many as 84% of today's leading organisations use agile and scrum processes; in the fourteenth annual survey (2020), the proportion was greater 95% (VersionOne, 2020).

This trend, nevertheless, does not mean that anyone has yet solved the problems of integrating agile methods in the overall long-term planning processes of large companies or groups of companies described above. The general formulations of the agile manifesto with its focus on customers, employees and results suggest a transfer to other areas outside software development in larger organisations. Also in academia a stream of more critical articles were published more recently (Naslund und Kale (2020), Piazza and Abrahamson (2020), Madsen (2020). Madsen (2020, p.1) states that agile project management gained popularity "driven by an active supply-side made up of actors such as consultants, coaches, and trainers" and hence has signs of a management fad. On the contrary side, some research remain optimistic about the viability and future development of agile project management and argue that it is a more lasting trend. Several reports published in recent years support this view (Denning 2018; Rigby and Bilodeau 2018). These reports conclude that agile project management has grown noticeably in acceptance and application in recent years (The Economist, 2018). Whether this can be done successfully, however, depends significantly on the application and the correct use of an effective approach fitting to the respective organisational situation. Hence it represents an opportunity for academic research as an item for investigation.

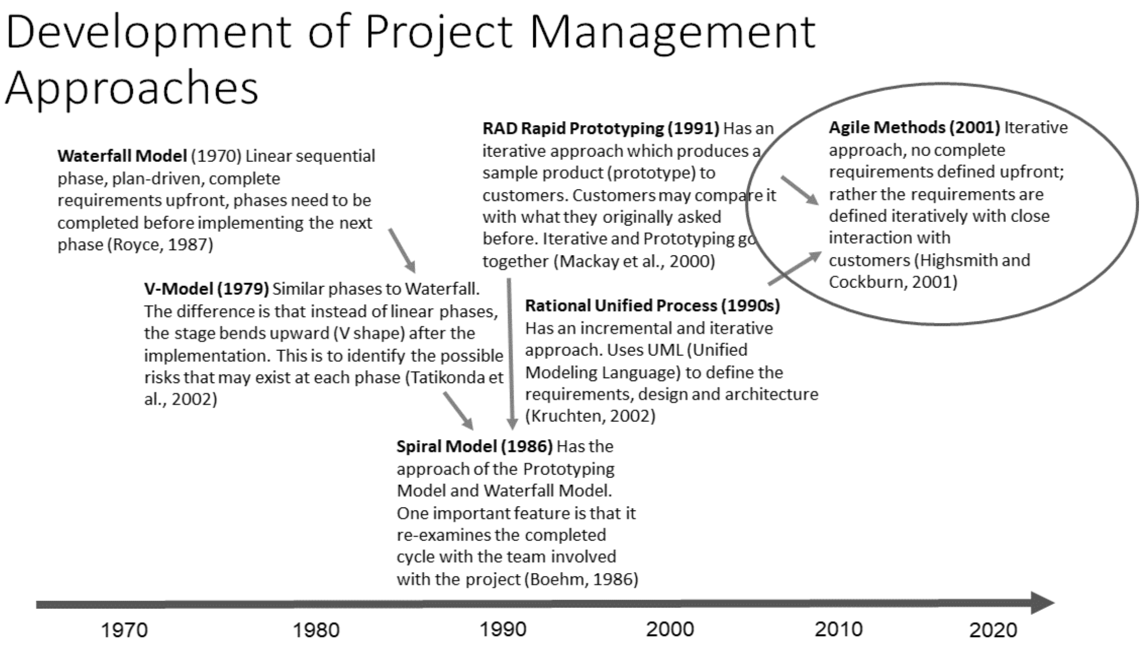


Figure 2.5: Development of Agile Project Management Approach

Source: adapted, with the author's deliberations, from Liu (2013) and Highsmith et al. (2001)

2.2.1 Scrum

Scrum is a procedural model of the agile product management of projects. It was first developed within software engineering but can also be used elsewhere in other practice areas such as product development.

According to Lui (2013) Scrum entails only a few rules: The Scrum framework needs only a few rules and techniques for implementation in activities, artifacts, and roles. It is based on the recently increased understanding that many software engineering projects are often too complex to be organised in the forms of traditional project management (Sharma et al, 2012). The assumption of Scrum is that the requirements for project goals can change in the course of a project, since new challenges or goals arise which were not known at the beginning or are subject to dynamics that appear only in the course of the project. In order to ensure the desired flexibility, teams generally work in shorter cycles – so-called "sprints" – to achieve constant improvements with a clearly defined content (Kurnia et al., 2018). The rapid achievement of sub-tasks, which make the first successes and findings visible, are essential features of this agile approach. The “fail fast – learn fast” principle is used consciously and is desirable for ensuring stable results through experience and iterations. Compared to the time of project initiation, changes and adjustments in the course of project are considered to be quite common and helpful (Rubin, 2012).

Planning in Scrum is developed iteratively to advance a product and is made up of the following artifacts (see Figure 2.6): the long-term plan (= product backlog) which is continuously developed and improved; and the detailed plan (the sprint backlog), which is created only for the next cycle of activities (= sprint). At the end of a sprint, the Scrum team is responsible for the delivery of a finished partial product (= product increment) and empowered to carry it out in principle, the product increment (as a potentially valuable product (= ‘in a ready to use, “shippable” state’) should be in a suitable condition for delivery to the customer. Following the cycle, the product, requirements and procedures are reviewed and further developed in the next sprint (Highsmith et al., 2001, Sharma et al., 2012, Liu, 2013).

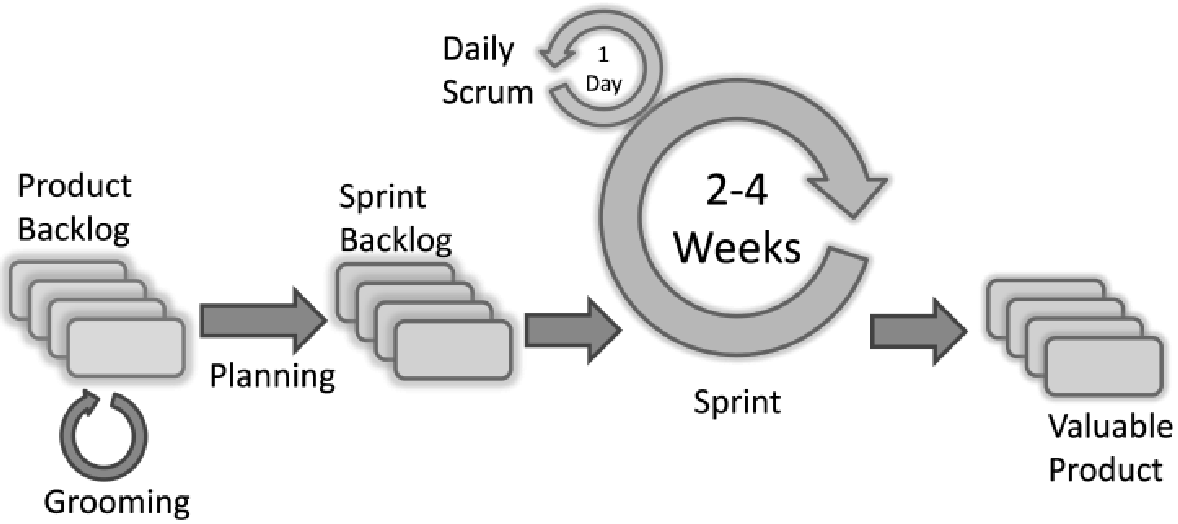


Figure 2.6: Scrum Model and its components
Source: Sami (2012)

Scrum has the following components:

- Scrum roles: Product Owner, Scrum Master and Scrum team

- Scrum activities: Sprint, Sprint planning, Daily Scrum, Sprint Review and Sprint Retrospective
- Scrum artifacts: Product Backlog, Sprint Backlog, product increment, release plan and impediment backlog

Scrum roles

The three key roles in Scrum are Product Owner, Scrum Master and Development Team. Each of them is assigned its own management function with specific responsibilities and tasks. Only if they are in perfect harmony can projects be successful. Despite the complete flexibility in agile project management, strict adherence to scrum rules is therefore of fundamental importance (Moe et. al., 2010). Of course, this always includes a clear differentiation of the roles in Scrum.

In addition, there are other roles such as users, stakeholders and management, which are usually not integral to the Scrum team.

The Product Owner and their role in Scrum

The task of the product owner is to know exactly the interests of users and stakeholders (user stories) and to represent them consistently. For this, the project strictly strives to see all aspects from the user’s perspective (Rubin, 2012). A link to the market and the customer is the basic principle of scrum project management insofar as it places its focus exclusively on the requirements to be implemented in development, deciding which product properties or functionalities should be developed and whether the requirements of the company are met. The customer is not involved in the development process during the individual Sprints, which is proxied in Scrum by the role of Product Owner, but the customer must be available throughout the project to make sure their requirements are incorporated in the process (Moe et. al., 2010). With this Scrum project management gets much better customer representation during the course of the project.

The Scrum Master and their role in Scrum

The Scrum Master acts as a moderator and service provider in the Scrum process and organises the development team's communication with the “outside world.” The scrum master is responsible for monitoring compliance with the values and rules of a project and creating suitable conditions for a successful project. These include providing resources, eliminating potential barriers, and mediating between the product owner and the development team, so the primary role of the Scrum Master is to help the team work smoothly within the framework of the Product Backlog and Sprint Backlog requirements (Kurnia et al., 2018, Timinger, 2017). As a neutral service provider, the scrum master is not “pre-assigned” to anybody, and makes no substantive decisions (Schwaber and Sutherland, 2017).

The team and its role in Scrum

As a rule, the team in Scrum consists of between four and twelve project staff and has an interdisciplinary set-up. Some authors such as Pries and Quigley (2010) prefer smaller teams; they recommend five to nine members. For the time being, specific hierarchies linking the individual areas of competence are not provided. During the sprints, the team organises itself and independently implements the required new product increments (Pries and Quigley, 2010). The goal is to create a propitious atmosphere that is largely free of disruptive external influences, which promotes the skills of each team member and thus helps to achieve the best possible results in a collaborative effort (Rothman and Kilby, 2019).

Compared to traditional project management, the role of the development team requires greater rethinking autonomy from the team and less monitoring of progress and reports. Many decisions are taken independently by the team, which also bears the consequences (e.g. due to inconsistency with other decisions) (Moe et al., 2010). This requires a different culture in the organisation but one which also starts from top management (Rothman and Kilby, 2019).

Scrum projects include additional roles such as customer, manager, supplier and maybe teams of other projects or workstreams. These roles however are often, unlike many traditional project set-ups, not part of the core project team (Wysocki, 209). Therefore, it is one of the primary responsibilities of the Product Owner to represent these stakeholders and their respective needs in the product development (Moe et al. 2010). The Scrum Master acts as a representative as well; s/he speaks for stakeholders from an organisational perspective (mediating or escalating impediments to development). Product Owners need a good relationship with the stakeholders too; their role is to have in-depth knowledge of the market so as to represent customers and their needs in the project, as and when required (Kurnia et al., 2018).

Scrum activities

The key characteristic of Scrum is to make continuous progress within two to four weeks, by means of self-contained cycles, called sprints. The goal of every sprint in Scrum is the implementation by the development team of a new product feature or product component (in agile software development, this is referred to as functionalities or increments).

This new feature must be mature enough at the end of each work session to be considered finished by the Product Owner and potentially delivered (Schwaber and Sutherland, 2017). In this way the quality or degree of maturity of the product is gradually increased.

Binding completion criteria

The basis for assessment is the so-called “Definition of Done”. This is also characteristic of agile project management methods such as Scrum and acts as a kind of checklist of concrete requirements, which the product owner and development team agreed on before the sprint started (Pries and Quigley, 2010). These requirements are usually formulated in the form of so-called user stories. Only when everything defined in these is done, with both sides agreeing on a binding completion or quality criteria being 100 percentage met, is the work section successfully concluded. During the sprints, the development team organises itself (Schwaber and Sutherland, 2017) and is not confronted with new requirements. It thus works on its own responsibility, which at the same time guarantees the flexibility of the project work that is the aim of agile project management.

Meetings, Review and Sprint Retrospective

Scrum Sprints follow a fixed chronology: first, the Product Owner, Development Team, and Scrum Master meet as part of a Sprint Planning meeting.

Based on the product vision stored in the Product Backlog (the dynamic plan initially outlined in its basic breakdown), the implementation steps for the next phase of work are coordinated. Not infrequently, management and users also take part in these 'kick-offs' (Pries and Quigley, 2010). The project participants discuss which product characteristic can be realized by the team in the next sprint. Once the tasks that need to be done to reach the sprint goal are agreed on, they are recorded in the sprint backlog (Rubin, 2012).

As noted previously, a Sprint is a fixed period in which the requirements for the product are implemented. A Sprint starts with sprint planning. This is followed by the implementation of planned user stories (see sprint artifacts). At the end of the sprint, the achieved product increment (result of the sprint) is checked (Sprint Review) and internal processes are optimized (Sprint Retrospective). Then immediately the next sprint sweeps in, which starts again with the planning (Pries and Quigley, 2010). An overview of the individual steps within a sprint is shown in Figure 2.6.

After this, the implementation phase begins. In 15-minute Daily Scrums the status quo is communicated at the beginning or at the end of each day (Timinger, 2017). As a rule, the Scrum Master and Product Owner also take part in this routine. In this way, any bottlenecks or problems can be identified early and straightened out (Rothman and Kilby 2019).

The literature usually assumes a fixed sprint duration of 14-30 days (Pries and Quigley, 2010, p. 88 and Diebold et al., 2017, Liu, 2013). Scrum teams often work together in the long term. The team composition and the sprint duration are therefore constant. This makes it easier for the team to estimate what can be done in a sprint than in other projects lacking this fixed framework. In any case, the duration should be kept constant during the project period (Pries and Quigley, 2010). Ideally, in comparable project types it is identical and constant across projects. A t the end of the sprint, all participants meet for the final sprint review (Kurnia et al., 2018). The result is presented and checked by the Product Owner to see whether the "Definition of Done" was satisfied, and whether the Sprint goal in question was reached (Viscardi, 2013). A downstream Sprint retrospective also serves for the timely exchange of experiences and the discussion of suggestions for improvement (Pries and Quigley, 2010).

Scrum Artifacts

Product Backlog (= the long-term plan)

The Product Backlog contains descriptions of the various requirements for the product (Liu, 2013). It is never considered complete, because it may change in the course of the project to keep up with changing customer needs (Timinger, 2017). The different requirements in the Product Backlog are described differently, depending on how well they have been understood. Requirements that are described in enough detail to be implemented becoming what is called "ready", which means that the item is completed (Pries and Quigley, 2010). The description of a request in the Product Backlog always includes an implementation effort estimate. Unlike the specifications in traditional project management, the estimation is always made by the person responsible for the implementation, i.e. the person who will do the requisite work at the end. This is important, for in traditional project management the project manager or the PMO might assign and estimate work without sufficiently consulting the persons or team who will actually do the work (Wysocki, 2019). Quite often, this results in disagreements between the Project Manager and the person or team who is supposed to deliver the work. Moreover, the Product Backlog is not exhaustive (Timinger, 2017). It is a living collection that is updated and detailed during the project implementation and therefore its scope can change over the course of the project. This is a significant shift in thinking from that of traditional project management. Because the product backlog is maintained continuously, it implies that there is a need to reconcile changes with the wishes of the stakeholders. It needs to contain enough requirements to have reached the "ready" state, especially if these requirements are needed for the next sprint.

Responsible for maintaining the Product Backlogs is the person who plays the role of Product Owner, as described above. Rothman and Kilby (2019). also identified improvements and bug fixes for the product, e.g. resulting from a sprint review and to be added to the Product Backlog as a main principle. The entries (i.e. product requirements) in the Product Backlog are numbered and ordered by importance. By this means, the importance of each requirement in relation to the others is defined. Thus, the Scrum approach embeds its implicit management of the importance of requirements, which consequently helps to focus on activities which are relevant for the customer and the deliverables. Even if one or two requirements are equally important, their order has to be defined before it can be entered in the Product Backlog. Because the order is articulated from the customer's point of view, a better focus is achieved on activities and tasks which are also important for the customer (Kurnia et al., 2018).

A backlog for a calendar app for example might look like the table below.

Table 2.1: Example of Product Backlog: Creation of a calendar app

ID	User Story	Type	Size Story Points	Priority	Classification
1	A weekly view of the calendar	User Story	40	150	Should have
2	**Create a new appointment (with date, time, description)**	User Story	**100**	**250**	**Must have**
3	Move existing appointments	User Story	25	150	Must have
4	Show day view	User Story	30	200	Must have
5	Show month view	User Story	30	100	Could have
6	Delete appointment	User Story	50	250	Must have
7	Import Holidays from other systems	Epic		100	Could have
8	Synchronization with mobile phone	Epic		150	Should have

All the main features for the mobile app are listed and decomposed in the backlog such as “A weekly view of the calendar”, “Create a new appointment” or “Move existing appointments”.

User Stories and Epics

The requirements are formulated in Scrum with so-called *user stories* and *epics* (Pries and Quigley, 2010). A user story is a requirement that is written from the point of view of a specific user role using the system or product, often that of the system user. A typical formulation could be “As a user, I would like to be able to create a new appointment in my calendar with just a mouse click" (Timinger, 2017). An *epic* is a larger, but still vague and ill-defined user story. At this point the requirements are only roughly defined and cannot yet be estimated in terms of effort. Especially at the beginning of a project, some requirements are still unclear. If requirements are not known or incomplete, the plans based on them are subject to uncertainties. Often assumptions are made at this point which later turn out to be wrong and lead to plan deviations (Kurnia et al., 2018).

In agile projects, uncertainties are accepted and clearly documented. Instead of a completely formulated user story, a so-called Epic is included in the Product Backlog. In other words, the Product Backlog consists of User Stories and Epics (Timinger, 2017).

The user story from Table 2.1 would simply be called calendar management as Epic. Epics help to remember nothing and can be understood in the Product Backlog as placeholders which must be elaborated later in detail. The example as shown in Table 2.2 could be further interfaced to other systems or mobile phones.

Scrum deliberately refrains from estimating the (implementation) effort of a user story in person days. Instead, it is the size of the user stories that is estimated. This is a measure of the complexity of a user story. A unit of this size is called Story Points. If a user story has twice as many story points as another user story, it is twice as complex.

Usually, test and documentation work belong to the implementation. Defining what exactly is required to implement the described feature is called the *Definition of Done* (Pries and Quigley, 2010). A user story is only fully implemented when all the work related to the user story has been completed and integrated into a working product increment. Consequently, all these works are to be considered in the estimation. Depending on the user story, different aspects must be taken into account in their implementation. The estimation of the size of the user stories in Scrum is often done in the context of a planning poker (= a workshop for estimating effort). All members of the development team, the Product Owner and the Scrum Master should participate (Moe et al., 2010). The task must be described completely in the form of user stories. The Scrum Master introduces the user stories to the developers, but only those questions are allowed which help gain an understanding of the work (Timinger, 2017). Then the team estimates the relative workload for the individual user stories. Each developer receives a set of cards with scores. The scores do not correspond to an absolute measure, but merely evaluate the relative workload of the user stories to be scored. If necessary, these so-called story points can then be converted into absolute cost estimates using person-day (PT) or man-day (MD) values for the sprint backlog (Kurnia et al., 2018).

Sprint Backlog (= detailed plan)

The Sprint Backlog describes the work planned for the current increment (called the Scrum Sprint).

This is done in a special meeting (Sprint Planning, see below) where suitable requirements from the Product backlog are selected (Kurnia et al., 2018).

In the above example (see Table 2.1) of a product backlog, refer to the entry "Task 2: Create a new appointment (with date, time, description)". In the Sprint Backlog, this entry could now be broken down into the following tasks (see Table 2.2):

Table 2.2: Example of Sprint Backlog

Scrum User Story 2: Create a new appointment (with date, time, description) Story Points: 100		
Scrum tasks estimates	Story Points	Effort estimate In man-days (MDs)
Creating dialog for appointment input	20	1 MD
Creating a database schema for appointments	40	2 MD
Connecting dialogue to database	30	1.5 MD
Testing appointment input	10	0.5 MD

The user stories of the Product Backlog describe the requirements of the customer or user (Pries and Quigley, 2010). From this, specific tasks have to be derived that must be implemented by the team to fulfil the requirements. This is done at the beginning of each sprint as part of sprint planning. The User Stories to be implemented in the following Sprint will be selected from the Product Backlog and formulated. for this task, called a scrum task. When a user story is split up into tasks, its total size specified in story points, is distributed in the form of individual tasks. Each task also receives a size estimate in the Story Point unit and a respective effort estimate. All sprint tasks are collected in the Sprint Backlog, as shown in Table 2.2.

Increment

The agile manifesto sets as its most important principle: “Our highest priority is to satisfy the customer through early and continuous delivery of valuable software”. With this principle, there is the thought of an iterative development. Behind this thought is also the idea that the customer should get a usable product, with a clear immediate value, which leads to the concept of increments (Pries and Quigley, 2010): At the end of each sprint a new product increment or usable product should have been created. A product increment is the result of a sprint. This can be, for example, a new software functionality or end product feature, e.g. the ability of the software to create a new appointment or calendar view, as shown above.

It is important that every single product increment is usable and/or presentable. The product owner or customer must be able to “try out” the new product increment. Only then can feedback be obtained, epics be concretised and user stories be completed. This project reduces the risk of doing the “wrong” feature or activities, which is a central benefit of the Scrum approach (Kurnia et al., 2018). The insight gained from these feedback sessions and meetings is then the central input into the planning of the next sprint.

The requirement that a product increment should be executable or presentable has an impact on the selection of user stories for the next sprint. The user stories must always be selected so that together they make something presentable (Timinger, 2017).

Although the central problems of the rigid Waterfall model are solved by the agile Scrum approach, some disadvantages of the Scrum approach are apparent. The independent working methods of the executing team put certain restrictions on planning security for the company. It is rather difficult to estimate which result is expected at the end of some sprints and of the overall project (Kurnia et al., 2018). The measurement of overall success is correspondingly problematic and also difficult for large companies to undertake if they are mainly used to medium and long-term planning (Tugra Demir, 2013).

Scrum has several advantages and can lead to significant productivity gains in the change management of companies. On the one hand, the client, the project team and other stakeholders work close together, so that customer need is at the centre of all sprint activities, and her/his wishes and concerns can be incorporated in the flexibility of the process. The self-organisation of Scrum teams does not require tedious control and heavy administrative processes (Moe et al., 2010). In addition, since responsibilities are clear, communication channels and structures allow issues to be identified and addressed during project execution (Timinger, 2017). The time-boxed Sprints, the Daily Scrum and the focus on transparency allow Scrum teams to adjust quickly if required. But there are also clear drawbacks. One possible disadvantage is that larger scale project endeavours with Scrum may lose the overview of the project as a whole and it is difficult to scale up the approach (Imani et al., 2017). The scrum approach might require the team to focus on the core activities of an individual customer, but this might lose the bigger picture or project objective. For instance, a software program might be designed exactly according to the client's needs, but the operations department might struggle to provide the efficient service with such software. Approaches to scaling up scrum try to address this clear disadvantage, but seem to have difficulties in coordinating the required activities and resources also, the lack of visualization of product and sprint backlog content can be a problem within the Scrum process (Hands, 2018).

2.2.2 Kanban Project Management

Another project approach that originated in the manufacturing environment and is now more frequently used in software development is Kanban. Originally, Kanban was used at Toyota to ensure "Just-in-Time" production. Instead of producing the products in a way that entailed a high storage cost, production was changed to minimize the storage time of the products. With the Kanban system, the pull system can be implemented, making production more efficient.

The term comes from the Japanese and is based on the procedure that was used at the time. 'Kanban' means 'sign' or 'map' in a simplified translation; during the implementation of the pull system signs were passed along the production chain to control resources and machines. With the help of the signs, it was possible to see directly where bottlenecks were occurring and which activities had to be carried out next in order to smooth out these bottlenecks.

Kanban was already in use at Toyota in the 1940s. The basic principles, which were formulated at that time, still exist. It reached full maturity in the 1970s and 80s as a method for increasing the flexibility and efficiency of the firm's production. It was only much later that David J. Anderson transferred idea of Kanban to the management of projects. Anderson was inspired by Lean principles, the formulation Theory of Constraint and the Kanban cards from the Toyota production system (Anderson, 2010). The theoretical foundations of Kanban are described in four basic principles and six practices. It shows that Kanban follows an evolutionary change management approach and strives for continuous improvement of the working method. The four basic principles and six practices are important to understand also because these concepts are used in project management.

The Kanban board is a tool for mapping and visualizing a workflow and as such is the key component of the Kanban method (Power and Conboy, 2015). The whiteboard is divided into columns and swimlanes. Each column represents a process phase, the swimlanes representing different task areas of the activities. When a task enters the workflow, it is placed on a Kanban card that traverses each column of the board. This is why it is called the "Kanban Task Board". Each Kanban board is divided into three main sections that show the status of the tasks (Dennehy and Conboy, 2018). The status may be To do, In Progress (with sub-states: such as development, test, deployment) or Done.

To detail the process activities, additional subsections can be created as required (to indicate sub-states, e.g. Development, Test, Deployment). Further variations are used in practice, e.g. incorporate, which is a quality assurance step, such as review or approval by product owner. The objective is to accurately visualize the workflow (Schweitzer, 2019). For example, a development team can use the sort of multi-column Kanban task board and swimlanes shown in Figure 2.7:

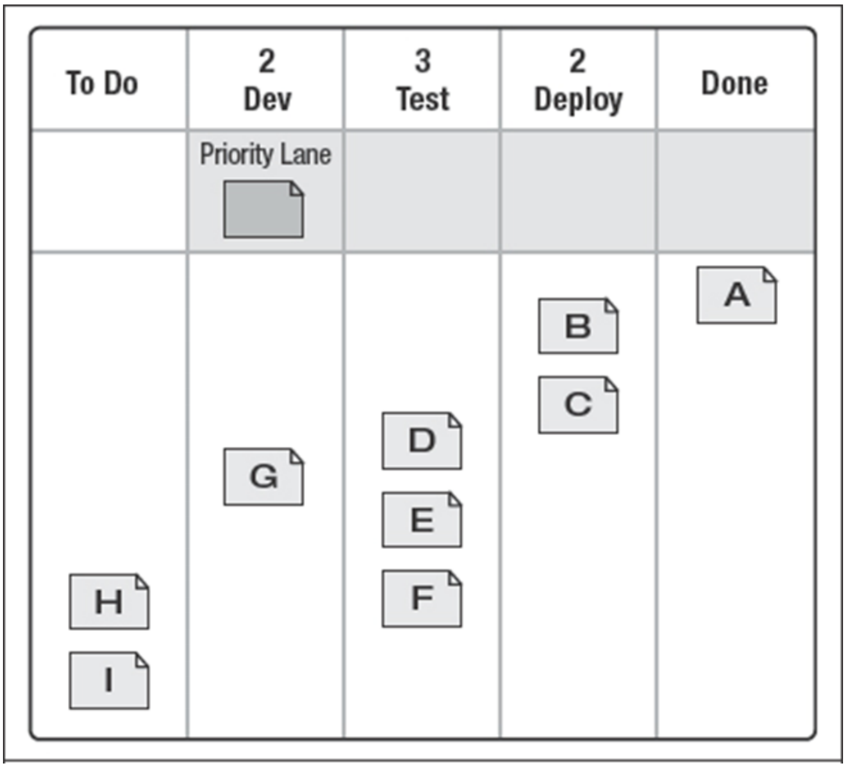


Figure 2.7: Kanban board in Software Development project management
Source: Dennehy and Conboy (2018)

Unlike Scrum, Kanban does not prescribe processes and structures in detail and it prescribes no concrete roles such as Scrum Master or Product owner or a Daily Scrum. Nor does it have fixed development times (it is not time boxed) as in a scrum sprint (Sjøberg et al, 2012). But this does not mean that such processes and elements cannot be integrated into Kanban project management. Many teams working with Kanban project management actually do meet daily at the Kanban board to discuss the current situation of the work packages and similar questions to those in the Daily Scrum.

The Kanban underlying the principles of the Toyota production system promotes self-organisation. It states that the employees independently take on the tasks themselves (= the pull principle) instead of being assigned to tasks by the project manager or PMO (Petersen et al, 2014). This implies that project managers fulfil a different role than that in traditional project management. Unlike Scrum, however, many projects have Kanban coordinated by a project manager (see, for example, the interviews in Dennehy and Conboy (2018). In practice, this quite often then requires a role that incorporates elements of traditional project manager, Scrum Master and Product Owner. The project manager might ask critical questions on the Kanban board, identify bottlenecks and with this criticality steer the team clear of problems and pitfalls. The project manager is also the interface with the management outside the core project and acts as an ‘escalation instance’ for the team (Schweitzer, 2019). Unlike traditional project managers, a Kanban project manager assigning and editing work packages leaves the team with similar freedoms to those in Scrum teams (Wysocki, 2019).

Anderson highlights the four basic principles of Kanban (Anderson, 2010):

a) ‘Start with what you are doing right now’, since too much time in a VUCA[1] world is often spent on extensive planning which in any case soon needs to be revised or adjusted.

b) ‘Strive for incremental, evolutionary change’, implying that change should not present a single major disruption but rather manifest itself in gradual improvements;

c) ‘Respect current processes, roles, responsibilities and titles’, meaning that change to be successful cannot be made in defiance of stakeholders but rather with them; and

d) ‘Promote leadership and accountability at all levels of the organisation’ indicating that change needs to be initiated by the leadership (Sjøberg et al, 2012, Goleman, 2000).

The first three principles are closely related. They emphasise the practicability and simplicity of introducing and using Kanban. The philosophy is that one can always start immediately from where one is. On this basis, the principle of constant improvements by small steps will improve the process and organisational structure in line with the basic principles and practices (Anderson 2011; Poppendieck & Poppendieck, 2013, Timinger, 2017).

Kanban can be started at once without much preparation (Anderson, 2010). This makes it easy to implement, but first the project manager and the team must know the current status of all activities and undertakings (Timinger, 2017). A starting point in implementing Kanban is to learn who is intensively involved in the project and who

[1] VUCA is an acronym for volatility, uncertainty, complexity, and ambiguity. It describes difficult general management conditions (Bennis and Nanus, 1985). The term originated in the 1990s in an American military college and was initially used to describe the multilateral world after the end of the Cold War. Later, the term also spread to other areas of strategic leadership and to other types of organizations from education to business (Bennett and Lemoine, 2014).

has which responsibilities and powers. This determines who is involved and how but also what task the project is currently doing and how.

In order for the Kanban system to run better in a modern environment the number of processes running simultaneously must be limited (Timinger, 2017). This makes it unnecessary to switch back and forth continually between processes, thus ensuring a better workflow and no distractions for the employees from their current project activities.

It was found in reviewing the effectiveness of Kanban that the Kanban system is a very good option for monitoring the work of international teams and distributing their capacities in the best way possible (Anderson, 2010). The pull principle ensures that only those tasks that are actually needed are completed. In project management, tasks are quite often completed when their interdependencies are complex but not great. If they are not connected with the completion of the overall task, the pull principle ensures that they are clearly delimited, which may improve the overall efficiency (Kniberg and Skarin, 2010).

Every project should use the work breakdown structure to keep an overview of interdependencies (PMI, 2017). Depending on a project’s complexity, priority and type, a combined approach in a hybrid project management set-up is well suited to a Kanban system (Timinger, 2017). Methods can also be combined, depending on implementation, but sometimes methods may contradict each other. The milestone trend analysis can very well be used to supplement the network plan. However, “the basic principles of the network and the Kanban system contradict each other considerably” … [since] “in a network, the activities are defined in detail beforehand, whereas in Kanban they are carried out flexibly according to the pull principle” (Schweitzer, 2019 p. 136). The benefit of the Kanban project management approach is that although this method provides only rough guidelines, it can be adapted to any project and hence is very well suited to hybrid project management (Timinger, 2017).

Kanban project management strives for incremental, evolutionary changes

If the current status is known, improvements can be made. The throughput time of the work on the project is a very important criterion by which the success of Kanban is measured. Steps must be taken that allow staff to record periodically the *lead time*[2] which makes the processes of project management visible (Kniberg ad Skarin, 2010).

Kanban insists that changes be made gradually (Anderson, 2010): It is based on evolution and not revolution. When the aim is not to lose important stakeholders and to take everyone along the path of change, minor changes are better than major, because they involve less risk that their consequences will not be fully captured and that the hoped-for improvement will not materialize.
Critics of evolutionary change fear that small changes will make any major innovative changes impossible. Successful managers know about this weakness of evolutionary change and regularly reflect on the status of their company or project (Timinger, 2017). In addition to evolutionary improvements, they examine whether it is even possible to gradually approach the optimum, or whether large, revolutionary changes are required for this. With the principle of incremental evolutionary change, Kanban follows the Plan-Do-Check-Act principle (Tague, 2005), referring to the continuous planning of improvements, their implementation, performance review and governance. However, improvements also require more radical steps and significant changes. An improvement is and will only be an improvement if it is set and applied over the long term. Some authors contradict Anderson's argument (2010) that all the relevant stakeholders must be involved in creating improvement, which requires other project management techniques and tools than a Kanban board. This is because Kanban is rather prescriptive, an insufficient approach, which needs to be supplemented (Kniberg ad Skarin, 2010).

Respect current processes, roles, responsibilities and titles
One consequence of the two basic principles outlined above is that current processes, roles, responsibilities and titles must be respected (Timinger, 2017). When changes are poorly initiated and communicated, the employees affected by them assume a position of refusal and block the planned changes wherever they can (Moe et al., 2010).

[2] Because the term 'cycle time' is here used more often, it is defined as follows:
- The total time a customer must wait to receive a product after placing an order. (source: https://asq.org/quality-resources/quality-glossary/l). Translated to a project context, the *lead time* is the time from the beginning of a work package or project to its completion.
- *Throughput* is the rate at which the system generates money through sales, or the conversion rate of inventory into shipped product (source: https://asq.org/quality-resources/quality-glossary/l). Translated to a project context, it is the number of work packages that can be fully processed within a defined time.

There are always employees who are satisfied only with the status quo and will not miss any chance to “torpedo” efforts to change it.

However, it may be useful or necessary to change processes, roles, responsibilities and titles to improve the organisation and its operations. But it is important to follow the second basic principle and let the evolution of change be incremental. The change must be explained in every detail to all the individuals whom it affects and a small team size is preferable (Fitzgerald and Stol, 2015).

As a rule, in line with the Kanban principles changes in the structure and procedure of an organisation do not fail because they are too complex, but because the affected persons are not involved in the change process and, as a result, object their utmost to the change (Kotter, 2012).

Promoting leadership and responsibility at all levels of organisation

Agility means, among other things, responsibility for individual managers. Transfer teams give them the freedom to self-organise. Kanban emphasizes this aspect in the fourth principle. Unlike Scrum, Kanban leaves the concrete design to the project manager, which is an important distinction since it lets him/her adjust better to new project management situations. Kanban is thus a consciously delineated form of Scrum and can be described as an independent process model. In practice, Kanban can be and is used independently as well as combined with Scrum or traditional procedural models for hybrid project management (Timinger, 2017). Hence it is listed in the survey as an independent approach despite criticism by other authors such as Kniberg ad Skarin, (2010).

2.2.3 Lean Project Management

Lean management combines principles and methods for the efficient, waste-free design of a value chain. Many of the ideas came from the production system of the Japanese car maker Toyota, which began its triumphal procession in the mid-20th century (Ohno, 1988). Meanwhile, Lean management is also used in non-production areas such as purchasing or project management. The German Association of Project Management (GPM) has acknowledged and added Lean project management in the dedicated project management section (Erne, 2019).

It is a very good example of a production management system, and its philosophy, can also contribute to project management.

The Scrum and Kanban procedural models presented so far not only implement the values of the agile manifesto[3], but also share some Lean production principles. They focus on the value-adding activities of the team and avoid unnecessary plans and sluggish project structures. Despite many similarities, however, Lean project management should not be “equated with agile project management” (Timinger 2018 p. 218).

Reviewing the theory of constraints as described by Eliyahu Goldratt (Goldratt and Cox, 2012) shows how these principles can be applied to Lean project management. Even if this is not the same as Lean management, the concepts help us to formulate practices which prevent waste in project management and show how this benefits the overall project management approach.

Lean principles

In the literature on Lean management (e.g. Womack et al. (1994), Womack and Jones (1996), Oliver et al. (1996), Delbridge (1998 and 2003), Hines et al. (2004), Shah and Ward (2003)) are found different principles in detail, embodying the Lean philosophy. In the context of project management, the following areas are relevant and Lean principles for project management can be derived from them (Timinger 2017): As a basic principle all major activities focus on the customers (Erne, 2019). The idea is that all major activities centre on customers and their needs (Womack et al., 1994). This is followed by the identification of the value stream (Delbridge, 1998). The idea makes use of an approach widely used also in Lean Management for project management to optimize value creation for customers and minimize waste (Hines et al., 2004). This first step in Value Stream Management is to map the flow of resources and information through the company. This is done from the customers’ point of view during production or order processing, because the customers determine the production requirements and all the processes involved (Womack et al., 1994). This flow, the value stream, is recorded, evaluated over time and displayed in the form of a flow chart with simple, standardized symbols. The value stream includes all the

[3] https://agilemanifesto.org/

process stages and activities that occur during each activity, both value-adding primary and non-value-adding support activities (Shah and Ward, 2003). The criteria for process evaluation and starting points for process improvement are the proportion (to be reduced) of non-value-adding activities, the order lead time (to be shortened if possible) and the proportion of processing time in the lead time (to be increased) (Womack et al., 1994). A pull principle is established, when there is a resource or activity "on stock" or idle, which means that tasks are pulled from one step to the next in a value-adding process. With this, a downstream step draws the tasks/materials/information from the previous step which signals the activities to be done to avoid idle or waiting time Hines et al. (2004). An ongoing evaluation should be carried out to enable the process steps to be continuously improved (Womack et al., 1994). These Lean principles can be applied to project management as well; at their core is the urge to avoid all waste (idle time, waiting time, produce on stock) (Erne, 2019). For instance, a project status report which is not used by management can be seen as a typical example of wasteful PMO resources in the area of project management. By using these 5 principles (Define the value for the customer, identify value adding activities, ensure a continuous flow, establish a pull principle and constantly improve) Lean project management is established (Erne, 2019).

The German Association for Project Management (GPM) publishes its own proposals for applying Lean management in projects (Erne, 2010), to emphasise the reduction of waste during the project lifecycle. This includes imprecisely recorded requirements, which necessitate the reworking of already discussed and agreed items. Solutions which are unnecessarily complex require effort, with corresponding customer dissatisfaction. Often, project team members need to work in parallel on frequent task changes. This "destructive" multitasking slows down project work because setting up each project task for each activity takes time. Erne also reports unnecessary interfaces in the project and between the project and other stakeholders which has no clear benefit and often simply imposes waiting time to accommodate unnecessary bureaucracy (Hines et al. 2004). Last but not least, Erne (2010) highlights the negative effect of unnecessary revision of the project objectives and scope, which has a detrimental effect on project productivity.

Before looking closer at the Lean principles and considering their concrete implications for project management, it may be useful to briefly discuss Goldrat's theory of constraints (Goldrat and Cox, 2012) in order to understand better the implications for Lean project management.

Theory of Constraints (TOC)

The key message of the theory of constraints is that the throughput of a system is determined by its given bottlenecks (Mabin and Balderstone, 2003). In project management this means, for instance, that if all tasks completed by the project have to be tested and documented by a single person, this limits the throughput of the functions throughout the entire system (here: the project). In this case, it does not make sense to specify or develop the deliverables more quickly, because of the bottleneck in the testing step. As long as this bottleneck remains the delivery of the overall system (project) cannot be accelerated.

For a project manager, a concrete instruction can already be derived from this observation: that it is always necessary first to identify any bottleneck in a project, to reform the way that it functions, to take further measures if necessary, to ensure the functioning of the bottleneck, and if necessary, to reform it further (Newbold, 1998). Figure 2.8 gives some guidance on the way in which the theory of constraints can be used in project management to ensure that Lean principles are used to improve project management (found in Timinger, 2017):

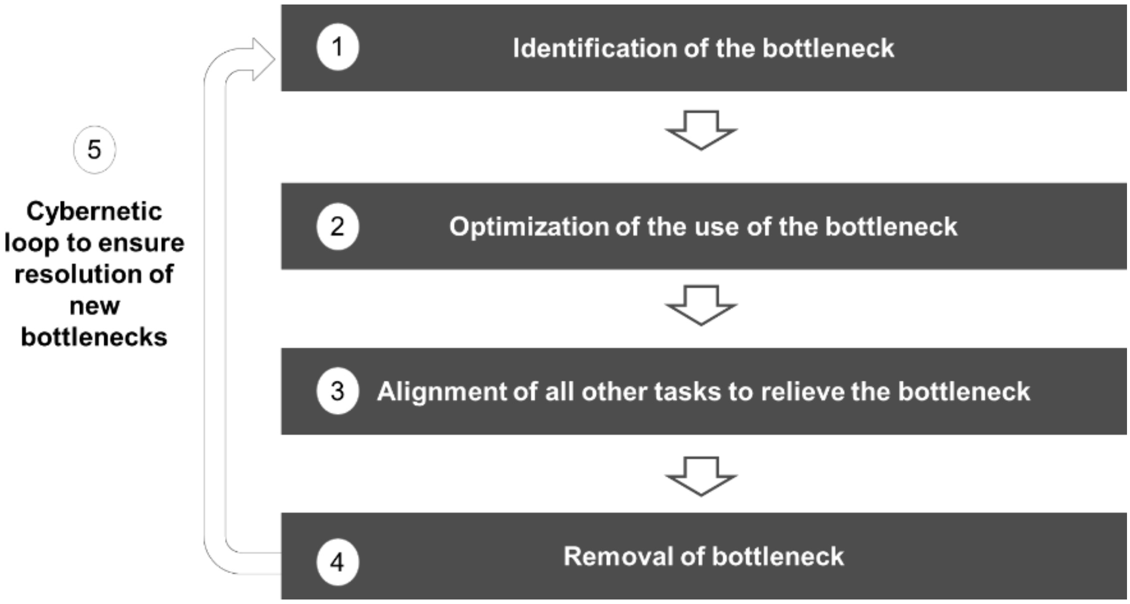


Figure 2.8: Process of bottleneck optimization to increase throughput in projects
Source: adapted from Timinger (2017) and Newbold (1998)

1. Identification of the bottleneck

   If a project is at all complex, it is difficult for the project manager to have all the work packages and employees in mind at the same time. It is therefore important to focus and intervene where a throughput is limited by a project bottleneck (see point 1 in Figure 2.8). In project management, observations similar to those of a production line can be made if the senior project management can answer the following questions:

   - Are staff waiting because other tasks need to be done or subcontractors are still at work? Does this translate into waiting time for other employees?
   - Do employees complain of overload which can be verified by evidence?

   A good approach is to compare planned costs and lead times with actual costs and lead times. For example, to visualize the flow and turnaround times, one can use a Kanban board or traditional Gantt or bar charts to visualize a bottleneck

2. Optimization of the location of the bottleneck

   Once the bottleneck has been identified the next step is to optimize its operation in the project. Again, it is helpful to translate the Lean Management production principles and adjust these to project management:

   - Activities that do not contribute to the success of the project should be eliminated (e.g. the activities of a line function – this may get confused in projects due to unclear roles and responsibilities.
   - It is important also to consider the on-going work balance. With this, tasks that other employees can do, so long as they themselves are not bottlenecks, should be transferred to them.

3. Alignment of all other tasks to relieve the bottleneck

   The area which has been identified as a bottleneck limits the speed of the successful completion of the project. It therefore does not make sense to invest in optimizing other tasks or employees – with two important exceptions:

   - Identify free resources which can relieve the bottleneck by taking on some of the tasks at this point, which should be reassigned for the purpose.
   - Identify for reassignment tasks which are an input to the bottleneck task so that the bottleneck does not have to wait for these inputs (i.e. the bottleneck should not be moved from one activity to another on the project where it could again clog up the flow of the system). The bottleneck limits the overall processing speed of the project.

4. Removal of the bottleneck

   From an overall project or program perspective it is important to take short-, medium- and long-term measures to minimize bottlenecks. Examples of this are:

   - Relieving the employee at the bottleneck by assigning tasks to other employees. Ensuring that skills are frequently spread over the project organisation e.g. via job rotation

- Improving the processes or tools used so that bottleneck employees can work more efficiently. For example, a typical issue on a project is having to wait for a management decision via bodies such as a Steering Committee. Other ways need to be found which do not clog up the project management system, such as circulation procedures for these inputs.
- Adding to employees' qualifications, so that someone else can take on tasks that only the bottleneck employee could once do.

5. Establishment of a cybernetic loop to ensure sustainability

   By repeating these steps, new project or program bottlenecks get identified and can be resolved, e.g. in one case a machine might cause the bottleneck which limits the project's progress. If a new bottleneck emerges, such as a sick person with a critical project task, the process should be repeated to ensure that this new bottleneck does not slow down the project. Thus, a regular check (a cybernetic loop, which is the science of communication and control theory) on new bottlenecks is important to make Lean project management sustainable and embedded in the project organisation.

By applying Lean principles and the principles of the TOC, Lean project management can establish itself. It can do so in the context of existing practices and tools (e.g. a Kanban board) to enrich existing project management practices, depending on the context, in the form of a hybrid project management approach.

2.3 Agile compared to Traditional Project Management

For many years, the Waterfall methods were the ubiquitous approach to project management. They are characterized by a sequential approach and used in various industries, especially software development. As we have seen, the name is derived from the often-used graphical representation of the project phases arranged as a cascade. Projects built on the Waterfall model consist of static phases that are processed in a predefined sequence (requirements analysis, design, test, implementation, maintenance).

One of the strengths of the Waterfall method is the comprehensive control possibilities in each project phase. The highly formalized process also increases the chance that all requirements will be considered in advance. However, these advantages are offset by serious disadvantages in terms of flexibility if, for example, the general conditions, assumptions or key data of the project change during its course. Especially in digitisation projects such changes are rather the rule than the exception. Hence, this is one of the main reasons why the Waterfall model has come under heavy criticism in recent years.

Agile methods pursue a fundamentally different approach in project management. They were developed primarily for projects where flexibility and speed were important. Agile projects are characterized by short delivery cycles, which are mainly organised in so-called sprints. Agile methods are best suited to projects that require relatively little control but need real-time communication within small, motivated teams. Agile project management relies on a high degree of interactivity between all the parties involved, which allows for quick adjustments during the runtime of the project.
Especially in software development projects, agile methods have become widely accepted and the “new norm”. Problems can be identified more easily and teams can make modifications early in the development process without having to wait for the completion of extensive test runs. The proponents of agile methods promise, among other things, reduced requirement risks, immediate feedback, less complexity and, in the end, faster results.

Since Waterfall and agile project management approaches are so different in philosophy, mindset and set-up, Waterfall approaches can be expected to fit well in predetermined and stable environments (complicated environments), whereas agile appears to be more adapted to situations which are more unstable and less predictable (complex environments). The situational aspect will be further discussed when the underlying theoretical Cynefin framework for this study is reviewed in Chapter 5.

In the next table, findings and reviews of the previous Chapters 2.1 and 2.2. and the findings of the various writers about both agile and traditional project management are highlighted and summarized.

Table 2.3: Differences in Traditional and Agile project management approaches
Source: adapted from Grushka-Cockayne et al. (2015), O'Sheedy, (2012), Dyba and Dingsoyr (2008), own deliberations

Characteristic	**Waterfall Project Management**	**Agile Project Management**
1. Philosophy	Minimizing risk, Process orientated	Speed of delivery, People orientated
2. Planning approach	Linear and predictive, upfront planning, notion of the predictability of planning, Focus on presenting the whole picture	Iterative and adaptive, minimal upfront planning, notion of unpredictability of planning and thus the need of an exploratory approach, higher focus on vision
3. Planning tool	Critical Path Analysis	Sprints and backlog
4. Focus	Achievement of a plan, completeness according to scope	Business Value, focus on a few most value adding activities
5. Value Measurement	Progress control by earned value management (EVM)	Progress control by 'burn down' chart
6. Requirements and Change Management	Fixed, detailed requirements defined upfront Change needs to be managed and controlled	Flexible, requirements determined in detail during project work Change welcomed throughout the project
7. User and stakeholder involvement	Managed by a stakeholder management plan on an "as needed" basis	Early and constant involvement, Co-management focus on customer and supplier cooperation
8. Decision-Making and project structures	Autocratic, hierarchical organisational structure, more inclined towards "command and control"	Decentralised, rapid and flexible response to change, towards leadership collaboration
9. Project Management cycles	Sequential process, focus on project stages (e.g. progressing one stage at a time, no overlap)	Sprint iterations, focus on product increments which can be delivered as a usable product to the customer or user
10. Project control/Project size	Project meetings and a steering committee, lessons learnt at the end of the project	Daily stand-up meetings and on-going sprint retrospectives
11. Complexity	Large and complicated	Small and complex
12. Team	Large and specialised teams, PMO managed teams	Small, multi-disciplinary teams, self-organising teams
13. Deliverables	Product delivery towards the end or in dedicated stages	Working product from day one (minimum viable product), constant improvements
14. Documentation	High emphasis on documentation	Low emphasis on documentation; use of tacit knowledge
15. Communication	Formal communication	Informal communication

In Chapter Two traditional and agile project management has been systematically compared and we clarified the differences between them. In the following Chapter Three the scientific basis for Project Success Criteria (PSC) and Critical Success Factors (CSF) in project management will be provided as a foundation to explain what is project success and which factors influence project success.

3. Literature review on Project Success Criteria (PSC), Critical Success Factors (CSF) and contingency theory

The following section first discusses the dependent variable of Project Success Criteria (PSC) to understand the definition of project success. This is followed by a review of project Critical Success Factors (CSF) to derive challenges and issues in project management. Based on contingency theory, a contingency fit model of CSF for the selection of project management approaches is presented as the theoretical basis for this research. Finally, the Cynefin framework is introduced to *describe* the variants of the situations as introduced by the contingency fit model. The following Figure 3.1 provides an overview of the literature review structure of the upcoming chapters.

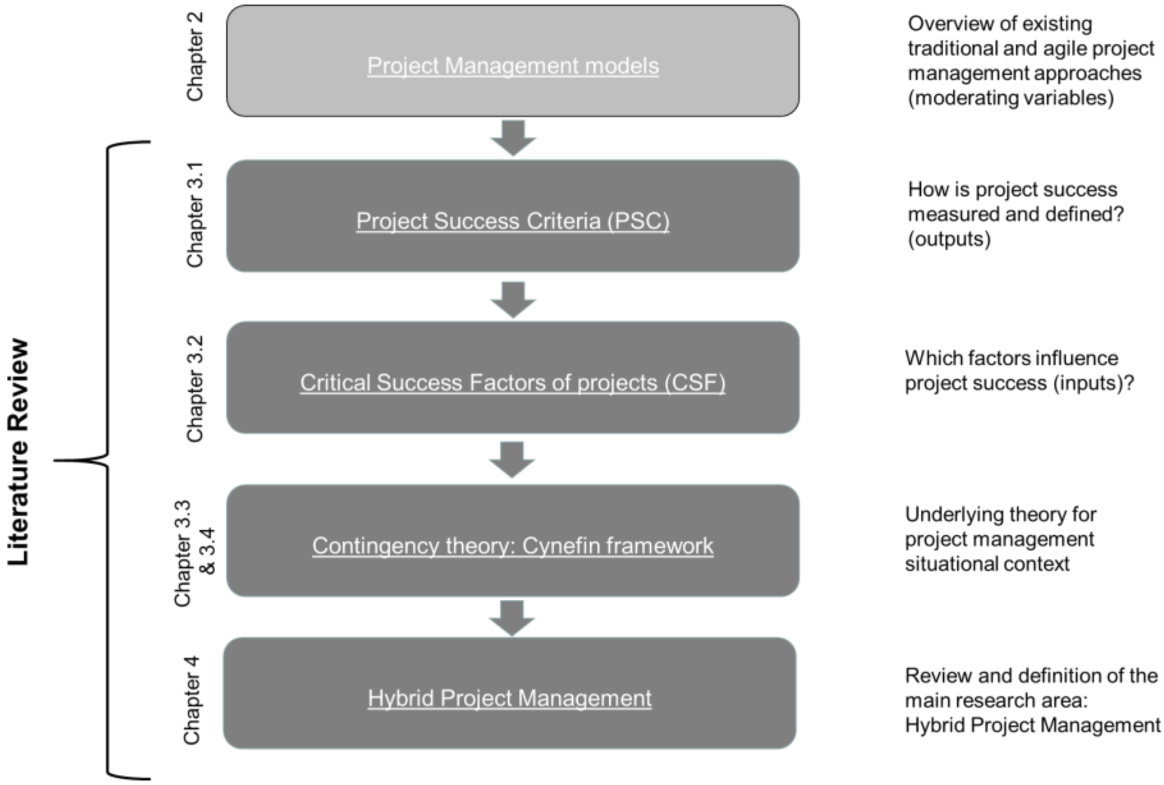


Figure 3.1: Overview of the literature review

3.1 Literature review for Project Success Criteria (PSC) in project management

Chapter 2 was dedicated to discussing the characteristics of the traditional and agile project management paradigms to grasp the differences between them. This section of the research discusses the definition and the measuring of a “successful project”.

During the review of project management literature it became evident that project success has been defined in many ways, though most writers in the past seemed to agree on the “magic” triangle. Hence, project success can be defined by the adherence to delivering projects on schedule (time), within scope (performance in what gets delivered) and budget (cost) (et al., 2017). Although the definitions of project success vary in detail, the magic triangle finds a high degree of endorsement in the literature (see Figure 3.2 and specifically Aguanno, 2005; Ika, 2009, Joslin and Müller, 2015; Serrador and Pinto, 2015, Cooper 2016). Hence a consensus could be said to support the view that the limitations of project can be – in a simplified sense – reduced to three, whatever the size or nature of the project (Schopp et al., 2019): the performance/quality of the project, sufficient time to complete the project and total costs. These three project factors can be described as the “iron triangle” of project management (see Figure 3.2 Traditional PM). The factors of performance, time and cost influence each other: Normally if one dimension is changed this will have a direct impact on the others (Atkinson 1999). If, for example, the performance or the quality needs to be increased (e.g. the number of functions of a new product), this usually has an impact on the time (it takes longer to complete) and commonly also requires more resources (and hence more money). The same holds true if e.g. the project has to be completed faster, which normally has an impact on what can be achieved (performance, in this context, especially on the kinds of function or feature that can be realized) and how much this will cost (more resources working in parallel and overtime, for example) (Albert et al. 2017).

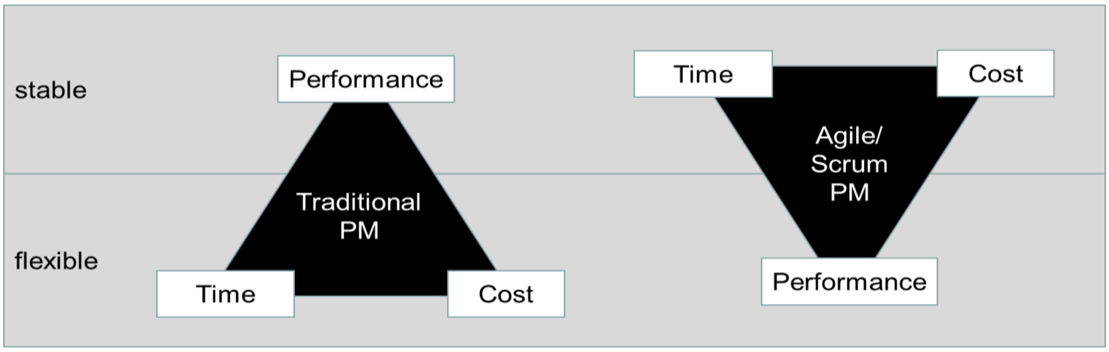


Figure 3.2: Comparison of traditional and agile Project Management approaches in relation to the dimensions of project performance, time and cost.
Source: adapted from Atkinson (1999) and Cooper (2016)

Philosophical differences between the Waterfall and the agile model can also be seen in the different representations of project management approaches in the "magic triangle". In Waterfall projects, activities centred on high planning reliability (Munassar and Govardhan, 2010). The orderly structure means that even large projects are precisely planned and reliably carried out, since the planning process, from requirements to implementation, must be firmly adhered to (the stable element). Hence the outcome in Waterfall projects (represented by performance or scope) is stable. Thus, the issues in project management often demand more time and/or higher cost (a flexible element) as shown in Figure 3.2 (Traditional PM). The agile/scrum paradigm is different because the performance/scope (what will be delivered) is flexible, but the framework uses fixed lengths of time (sprints) and therefore mostly keeps the costs fixed (see Figure 3.2 (Agile/Scrum PM)).

However, in more recent studies (Schopp et. al., 2019), most authors no longer see the "magic triangle" (cost, quality and time) as a good enough way to indicate project success (Schopp et al., 2019). Additional dimensions are needed which now seem to be important. These modifications of the magic triangle address the fact that projects are run in different environments and therefore success criteria are different from one case to the next (Aguanno, 2005; Ika, 2009, Joslin and Müller, 2015; Serrador and Pinto, 2015). Despite broad agreement on the magic triangle, the different focus of the various studies and the comparison of factors probably also prevent an even higher degree of agreement from prevailing (Schopp et. al., 2019). Nevertheless, it can be seen that some factors are mentioned with an acceptable level of agreement much more often than others. This should be noted and interpreted as a strong indication for other Project Success Criteria (PSC) to be added to the "magic triangle", namely, stakeholder satisfaction (management, employees/team performance, stakeholders), customer satisfaction, business success (return on investment, costs, product success) and risk management (Schopp et. al., 2019). These are also considered a basis for this research. Table 3.1 summarises the literature found with regard to Projects Success Criteria (PSC) and the factors found to influence project success, known as Critical Success Factors (CSF), which are covered in the next section of this chapter.

Table 3.1: Summary of literature review findings
Source: adapted from Schopp et al. (2017) and enriched by Ahimbisibwe et al.(2017), Aguanno (2005); Ika, (2009), Joslin and Müller (2015); Serrador and Pinto (2015), Hoegl and Gemünden (2001)

Study	**Topics examined and project type**	**Definitions of the outcome project success criteria (PSC)**	**Methodology and type of evidence**	**Identified critical success factors (CSF)**
Aguanno (2005)	- Benefits of agile project management	- Customer satisfaction - Leadership satisfaction	- Literature review	- Prioritization of efforts, clear goals - Amicability (customer feedback) - Planning flexibility (scope) - Stakeholder/top management support - Risk Management
Alexandrova and Ivanova (2013)	- No specialisation on a topic - All types of project	- "Magic Triangle" (cost, time, quality) - Customer satisfaction - Stakeholder satisfaction	- Questionnaire - Limited empirical, quantitative evidence	- Project manager & team member competence - Compliance with rules and procedures - Stakeholder/Top management support - Quality of subcontractor services
Ahimbisibwe et al. (2015)	- Top management support - All project types	- "Magic Triangle" (cost, time, quality) - Top level support - Culture	- Questionnaire - Literature review - Empirical, quantitative evidence	- Project manager leadership - Top management support
Arumugam et al. (2013)	- Professional expertise - Learning behaviour of project team and manager - Six Sigma projects	- Creation of additional value to customer - Cost advantage	- Questionnaire - Literature review - Empirical, quantitative evidence	- Experience & knowledge of project manager - Team climate
Badewi (2016)	- Benefits & project management of IT projects	- "Magic Triangle" (cost, time, quality) - Return on investment	- Questionnaire - Empirical, quantitative evidence	- Benefits management - Project management planning and control
Bredillet and Dwivedi (2009)	- Influence of working motivation to project management success	- "Magic Triangle" (cost, time, quality) - Customer satisfaction - Project quality - Success of implementation	- Questionnaire - Empirical, quantitative evidence	- Working climate & objectivity Correlation between work motivation and project management success - Communication
de Bakker et al. (2010)	- Does risk management influence IT project success?	- "Magic Triangle" (cost, time, quality) - Customer satisfaction - Team performance - Risk management	- Journal articles from 1997 to 2009	- Risk sensitivity of stakeholders - Behaviour of stakeholders during risk management process - Risk factors (technical & organisational)
Fabricius and Büttgen (2015)	- Risk expectation - Overconfidence of p. manager - All project types	- "Magic Triangle" (cost, time, quality)	- Questionnaire and field study - Empirical, quantitative evidence	- Realistic planning of cost and time - Project manager consideration of risk impact
Frey et al. (2009)	- Success factor identification - Knowledge management to support project success	- "Magic Triangle" (cost, time, quality) - Customer satisfaction	- Interviews - Questionnaire	- Four success categories, project/clear deliverables - Relation between project communication management and success - Functioning IT infrastructure & high process quality
Gudienė et al. (2013)	- No specialisation - Construction projects	- "Magic Triangle" (cost, time, quality)	- Questionnaire and field study - Empirical, quantitative evidence	- Project manager & team competence - Clear definition of project objectives/goals
Handzic et al. (2013)	- Project customer - Qualified project team - Structure of project process - IT projects	- "Magic Triangle" (cost, time, quality)	- Literature review with partly empirical data - Limited empirical, quantitative evidence	- Qualified project team - Project manager competence - Customer relationship to project process - Structure of the project process
Hoegl and Gemünden (2001)	- What is "teamwork," and how can it be measured? - Why and how is teamwork related to the success of innovative projects? - How strong is the relationship between teamwork and different measures of project success?	- "Magic Triangle" (cost, time, quality)	- 145 software development teams - Interviews - Questionnaire	- Team performance effectiveness - Team performance efficiency and resources - Personal success in work satisfaction - Personal learning

Joslin and Müller (2015)	Project management methodology (PMM) and project success, and the impact of project governance	Project governance acts as a quasi-moderator in this relationship	- Questionnaire - Empirical, quantitative evidence	- Project Management Methodology can now be added as a success factor to the project success literature
Ika et al. (2011)	- Relation between critical success actors and project success - Success dimensions	- Monitoring - Coordination - Design - Training	- Questionnaire	- Insights from project management literature - Specific CSF set for World Bank projects (monitoring, coordination, design, training)
Ika et al. (2012)	- No specialisation on a topic - World Bank projects	- “Magic Triangle” (cost, time, quality) - Customer satisfaction	- Questionnaire - Empirical, quantitative evidence	- Qualified and trained project team - Clear definition of project objectives - Project monitoring & risk management
Mir and Pinnington (2013)	- No specialisation on a topic - All project types	- “Magic Triangle” (cost, time, quality) - Customer satisfaction - Business success	- Questionnaire - Empirical, quantitative evidence	- Project manager leadership - Management of key performance indicators - Qualified project team
Papke, Shields, Boyer and Wright (2017)	- No specialisation on a topic - All project types	- “Magic Triangle” (cost, time, quality) - Customer satisfaction - Business success	- Literature review with partly empirical data - Limited empirical, quantitative evidence	- Project management and planning - Trade-off between cost, quality and time
Serra and Kunc (2014)	- Benefits Realisation Management - IT projects	- “Magic Triangle” (cost, time, quality)	- Questionnaire - Empirical, quantitative evidence	- Benefits Realisation Management - Clear definition of project objectives - Keep monitoring of project outcome after closure - Realistic planning of cost and time
Serrador and Pinto (2015)	- Agile methodology - All project types	- “Magic Triangle” (cost, time, quality) - Stakeholder satisfaction	- Questionnaire - Empirical, quantitative evidence	- Agile methodology (for IT and high-tech projects) - Clear definition of project objectives
Shokri-Ghasabeh and Kavousi-Chabok (2009)	- Generic project success criteria and factors - All project types	- Definition differs - “Magic Triangle” (cost, time, quality) - Product success - User/stakeholder needs satisfaction	- Questionnaire - Literature review	- Success factors are not universal for all projects - Project control/scope/change/contracts - Project team and accountability - Top management support - Resource availability - Project risk management
Taherdoost et al. (2016)	- No specialisation on a topic - All project types	- “Magic Triangle” (cost, time, quality) - Sustainability	- Literature review with partly empirical data - Limited empirical, quantitative evidence	- Qualified project team - Leadership of the project manager - Clear project objectives
Xu et al. (2010)	- Benefits from team-work quality and impact on project success	- “Magic Triangle” (cost, time, quality) - Customer satisfaction - Achievement of objectives - Monitoring of costs	- Questionnaire - Empirical, quantitative evidence	- Team-Commitment - Team-work quality, team culture - Actual/achieved effects are synonymous

3.2 Literature review for Critical Success Factors (CSF) in project management

Many projects fail or are judged to be of limited success because the essential goals are not achieved or are not achieved to the desired extent (Hornstein, 2015). Methodological support in form of project standards for the successful execution of projects is available and is supported by project practice representatives and associations such as the Project Management Institute (PMI), the International Project Management Association (IPMA) or The Office of Government Commerce (Prince2). Nonetheless, there is still a debate over which factors are responsible for the successful achievement of objectives. Among the many studies (see Table 3.1), examining the success factors, traditional, agile **and** *hybrid* approaches have not been compared. Hence, the answers to these questions and the specific success measurement, the research methods and also the results are still rather heterogeneous. Some are derived from extensive collections of primary data; others rely on existing knowledge (see Table 3.1: column Methodology and type of evidence).

Taking into consideration the CSF result from Table 3.1, the highest degrees of agreement can be seen in four factor categories (Ahimbisibwe et al. 2017):

1. Organisational factors
2. Team factors
3. Customer & stakeholder factors
4. Project uncertainty factors

In the following section are the CSF derived by PSC in project management which are specifically used to describe the success of projects in traditional and agile project management settings. Consistent with previously listed studies, available research on this topic was identified from various data collections (survey, online survey, questionnaires, interviews, literature reviews). The research on the literature gathered various project sizes, industries, geographical locations. The main difference from the current study is that it does not yet reflect previous studies' differentiation between *hybrid project management* approaches, whereas this study does. Many studies focus on either traditional or agile project management practices or compare the two, but no study explicitly represents hybrid project management approaches in its discussions.

Reviewing the CSF in the literature listed above, it should be noted that not everyone agrees on definitions. In most of the 22 papers (see Table 3.1) it appears that top management, customer and stakeholder support, followed by team dynamics factors, are the most critical success factors that can be identified in the literature. Other important factors are those which centre on project uncertainties and risk factors.
Some confusion in the literature stems from the fact that some authors do not seem to differentiate clearly between project Success Criteria (PSC, = project output, dependent variables) and project Critical Success Factors (CSF, = factors which independently influence project success, an independent variable)[4]. This creates confusion over what has been measured and hence on the interpretation of the results. Hence, for this study clearer differentiation has been attempted.

3.2.1 Organisational factors

The group of organisational factors consists of the following:

Customer organisation factors are factors that lie outside the project organisation but are derived from the context of the organisation and affect the way that project works can lead to project success (Howell et al., 2010). The environment in projects is often strongly influenced by the organisation in which the project is run. Hence project management is often influenced by its organisational factors (Ahimbisibwe et al. 2017).
The organisational CSFs that can be found in the literature comprise (Howell et al., 2010):

- Communication
- Capability for organising change
- Planning and control
- Ability to cope with contingencies

These are constructs that largely apply to top management decision making, stakeholder management, and the influence of organisational corporate culture (Slevin

[4] See also Ahimbisibwe et al. (2017), p. 403

and Pinto, 1988). It is therefore logical to hypothesize that different projects face different constraints imposed by their particular organisational structures and that this results in the need for different project characteristics to achieve a best fit (Howell et al., 2010). Traditional project management approaches tend to come from organisations where the structures are more bureaucratic and value scheduling and control procedures. Agile project management, in contrast, are best suited to organisations “with organic and flexible structures that support more informal communication and the empowerment of the project teams” (Ahimbisibwe et al., 2017). The support of the highest management level is among the organisational factors suggested as the main CSFs for projects in general (Ahimbisibwe et al. 2017). Slevin and Pinto (1988) and Frey et al. (2009) have identified communication as an important CSF, although some authors (e.g. Müller and Jugdev, 2015) objected that communications “were found to be unstable” at time, depending on the type of project. In addition, De Bakker et al. (2010) reported that risk management has a positive impact on project success.

Hence, in the present research the following project management issues and challenges are identified as an organisational factors group based on the findings in the literature:

- Communication (CO)
- How to organise change (OC)
- Risk management (RM)

3.2.2 Team factors

Team factors relate specifically to questions for the project teams and in theory are assumed to have a positive impact on the success of projects (Ahimbisibwe et al., 2017). The success of a project depends heavily on the communication within the team and from the team to other stakeholders (McManus, 2007, Moe et al. 2010, Rothman and Kilby, 2019) but also in regard to the ability to manage change, the experience, commitment and composition of the team (Howell et al., 2010).

Often these factors relate specifically to employees or project teams. Some factors like team empowerment, composition, size, and geographic distribution are also commonly influenced by the parent organisation and the broader corporate culture inherited from it (Ahimbisibwe et al., 2017). As a consequence, Ahimbisibwe et al.

(2017) conclude that the team's empowerment, composition, size, dispersion and organisational boundaries can all affect the communication skills or commitment of the team.

In situations where small teams organise themselves autonomously, with highly qualified specialist knowledge and are highly cooperative and engaged, agile methods should be used (Wysocki, 2019), and the opposite holds true for traditional project management approaches. Ramesh et al. (2006) have found that team members with great motivation had a positive impact on the perceived success of agile projects with a positive relationship between the team's commitment and the agile project success. Similarly, the cost of supervision is mitigated to the extent that the members of the project team are committed to their project tasks (Ahimbisibwe et al. 2017). Adequate communication improves the levels of information exchange and collaboration between the members of the project team, which reduces the number of team member conflicts and keeps the conflicts minimal, achieving stability in project teams and thus avoiding project delays (Rothman and Kilby, 2019). This is because project management activities often require knowledge-intensive skills while people-intensive activities involve cooperation among team members with different skills and specialisations (Ahimbisibwe 2015, Ramesh et al. 2006). Furthermore, adequate internal project communication creates a sense of responsibility and connection between the team members and the project tasks that the team owes to the project. This results in an atmosphere in which the individual team members can act without the need for much control and coercion (Ahimbisibwe et al. 2015, Rothman and Kilby, 2019). Teamwork, skills and abilities also positively influence project success (Ramesh et al. 2006, Boehm and Turner, 2003; Ahimbisibwe et al. 2017). Taherdoost et al. (2016), Xu et al. (2010), Hoegl and Gemuenden (2001) carried out intensive research on CSF in teams and identified, as in previous findings, that team effectiveness and efficiency are major project success factors. They emphasise team quality, i.e. communication, coordination, balance between members’ contributions and mutual support [= accountability], effort and cohesion, team skills and learning.

Therefore, the following project management team issues and challenges have been identified as forming a team factors group, based on the findings in the literature:

- Accountability (AC)
- Team dynamics/team building (TD)
- Team skills (TS)

3.2.3 Customer & stakeholder factors

Customer descriptions of the influence of customers on projects on project success are mainly referring to the level of interaction and participation during the project. This is essential, since too little input on requirements and feedback on project deliverables risks the success of a project. Ika et al. (2012) and Handzic et al. (2013) show that customer relationships are key to project process and that there is a success significant and positive relationship between customers and participation in the success of a product development project. Gudienė et al. 2013 show that the clear definition of project objectives is a key CSF of construction projects. Taherdoost et al. 2016 conclude that this holds good for every type of project and show that determining which solution fits the organisation and its stakeholders is of great importance because a project, even if undertaken correctly, is not fulfilling its objectives if it still does not fulfil customer needs and hence must be considered a failure. Yetton et al. (2000) found that customer participation tends to increase the budget variability because it encourages more change requests. However, they also found that participation if integral to the project set-up, also reduces budgetary deviations through expectation management and quick attention to possible gaps between expectation, requirements and product. Hence, conflicts that arise early on through greater customer participation play an important role in the overall satisfaction between project team members and customers (Mir and Pinnington, 2013), especially in software development projects (Ahimbisibwe et al., 2017).

Hence the customer must be able to unambiguously articulate his/her needs, otherwise an entire project is endangered. This is confirmed by Ahimbisibwe et al. (2017), who found in their research that customer factors have a direct positive influence on project success. Slevin and Pinto (1988) identified stakeholder support, especially by top management, in the articulation of project objectives and the derived mission of the project as one of the strongest factors influencing project success. This was supported later by Shenhar et al. (2002) and especially highlighted for top management support by Shokri-Ghasabeh and Kavousi-Chabok (2009) and McManus (2007). Hence, the following factors in capturing issues and challenges have been identified as forming a customer & stakeholder factor group:

- Stakeholder support and engagement (SS) (a.k.a. Top Management Support)
- Goals or requirements (GR)

- Determining which solution fits the organisation and its stakeholders (OS)
- Clarity in expectation management and deliverables (EM)

3.2.4 Project uncertainty factors

Projects are not only innovative and often in need of high investment; they also contain many uncertainty factors that make them difficult to manage. Project uncertainty factors stem from project complexity and interdependencies but also provide sufficient resources when needed for the effective prioritizing of tasks and activities. The most important project uncertainty factors identified from the literature are: complexity and uncertainty, relative project size, urgency, and scope changes (Ahimbisibwe et al. 2017). Risk factors can arise during project execution (Shokri-Ghasabeh and Kavousi-Chabok, 2009), but many of these risks are project specific characteristics that existed from the moment that the project was initiated (Ahimbisibwe et al. 2017). These uncertainty factors are inherent and at various levels which can affect the contributions from other CSFs to the project success (Jun et al., 2011). For example, project planning and project monitoring imply a greater contribution to project success from traditional projects where little is uncertain than from agile projects (Ahimbisibwe et al. 2017). Likewise, user participation makes a greater contribution to project performance from agile projects which have a “high level of inherent uncertainty than with traditional, low-level, schedule-driven projects” (Ahimbisibwe et al. 2017, p. 27). Hass (2008) views complexity and uncertainty as aspects of the same variables.

Howell et al. (2010) argue that project management problems which are related to complexity often focus on the ability to understand the situation. They argue that the lack of predictability is identical to uncertainty and thus complexity should be seen as an uncertainty factor (Howell et al., 2010). Furthermore, urgency also creates uncertainty, just as complexity does, by limiting the chance of understanding the situation. Uncertainty arises because of decisions that are based on limited information (Howell et al., 2010). Hence, managers under time pressure also tend to accept more risk and often take inadequate measures (due to omitting reflection in the decision-making process) to avoid situations that have a negative impact on project success (Ahimbisibwe et al. 2017). Similarly, Jun et al. (2011) have found that not knowing enough about customer needs makes it difficult to define comprehensive, explicit or consistent project requirements. It can result in an outcome that does not meet customer requirements and subsequently requires changes to the product and hence change requests to the project. Jiang et al. (2006) also shows that uncertainty has a negative impact on project success. Therefore, project uncertainty factors are important for project success (Aguanno, 2005, Vinekar et al., 2006 and de Bakker et al., 2010). To conclude, project factors such as frequent changes, prioritisation and planning pressures, resource conflicts and complexity can also negatively impact on the success of a project (Ahimbisibwe et al. 2017) and should thus be part of CSFs.

Therefore, the following factors to represent issues and challenges have been identified as the project uncertainty factor group:

- Scope changes (SC)
- Prioritizing of task and activities (PT)
- Resource conflicts or deprivations (RC)
- Planning and deadlines (PD)
- Insufficient understanding of complexity and interdependencies (CI)

Table 3.2 summarizes the Critical Success Factor in Projects, which are also used for this research in hypothesis testing.

Table 3.2: Project Success Factors used in this research Adapted from Ahimbisibwe et al. (2017)

Category	Critical Success Factor in Projects	Hypothesis
Organisational factors (OF)	1. **Communication** (CO)	H1
	2. **Clarity in describing how to organise change** (OC)	H2
	3. **Risk management** (RM)	H3
Team factors (TF)	1. **Accountability** (AC)	H4
	2. **Team dynamics/team building** (TD)	H5
	3. **Team skills** (TS)	H6
Customer & stakeholder factors (C&SF)	1. **Stakeholder support** and engagement (SS)	H7
	2. **Goals or requirements** (GR)	H8
	3. Determining which **solution fits the organisation** and its stakeholders (OS)	H9
	4. **Clarity in expectation management and deliverables** (EM)	H10
Project uncertainty factors (PUF)	1. **Scope changes** (SC)	H11
	2. **Prioritizing of task and activities** (PT)	H12
	3. **Resource conflicts or deprivations** (RC)	H13
	4. **Planning and deadlines** (PD)	H14
	5. **Understanding of complexity and interdependencies** (CI)	H15

3.3 Contingency theory as an underlying hybrid project management theory

Social scientists from the 1960s onwards developed the situational approaches of organisational theory. The studies focused on the relationships between the specific variables of the "situational environment" in question and the organisational structure and their efficiency. Two basic ideas have been characterized as the contributions of the situational approach (Pugh et al. 1969):

1. There are differences in organisational structures and behaviours of the organisational members due to differences in the situation in which the companies find themselves.
2. Organisational structures and behaviour vary in efficiency depending on the situation.

As a conclusion, a generalizable optimal form of organisations – and in the form of temporary project management organisations – does not exist. Instead, the firm typology of organisational structures is abandoned in support of the description of organisations by means of adjustable constructs with different features depending on the situation (Schulte-Zurhausen, 2014).

Organisational contingency theory developed out of this, which argues that projects have different set-ups and environments and "thus should adjust to the respective environmental situation" (Howell et al., 2010, p. 256).

Donaldson (2001) describes the contingency approach on an abstract level: contingency theory states that the effect of one variable depends on another to a third variable, W. Hence the "effect of X on Y when W is low differs from the effect of X on Y when W is high. For example, if W is low, X may have a positive effect on Y, while if W is high, X has a negative effect on Y. Therefore, it cannot be said how X affects Y unless W is known. There is no consistent valid connection between X and Y that can be specified. The relationship between X and Y is part of a more complex causal system that includes the third variable, W, so that the valid generalization takes the form of a trivial relationship" (Donaldson, 2001, p.6). A bivariate relationship is too simple to grasp the regularity that connects X and Y (Saeidi et al., 2019, and

Ahimbisibwe, 2015). Therefore, a more complex causal statement is required (Donaldson, 2001). The third variable, W, moderates the relationship between X and Y and can therefore be called a moderator of the relationship or a condition variable of the relationship, as Galtung (1967, in Donaldson (2001) has described.
This also holds true for temporary project organisations and their organisational context (Snowden, 2019). For example, a fixed project management structure as described by traditional project management standards can be highly effective when the task certainty contingency is high, and a more flexible structure such as the agile Scrum project management approach is highly effectiveness when task *un*certainty is high. The reason for focusing on effectiveness in contingency theory is that organisational theory has tried to explain the success or failure of organisations (Donaldson 2001), in ways which can also be applied to project management (Kureshi 2013).

The following figure, Figure 3.3 represents the contingency fit model for this research (based on the situational context as described by the Cynefin framework): Just as different employees should be managed according to the situation, the approach to each project management problem should also be adapted to the environment at hand. This is due to the fact that whatever leads to good solutions in one environment can be ineffective in another environment as introduced by contingency theory. In this regard, the Cynefin framework helps us to better understand and to classify project management situations. Hence, depending on the situation and environment, projects are implemented in simple, complicated, complex or chaotic systems. And for each system there is its own promising approach to solving the problem. But if a solution approach is chosen that does not fit the system at hand, the risk of failure could be high.

As the underlying model for this research, it describes how Critical Success Factors (CSF) result in project outcomes (= project success, measured by Project Success Criteria (PSC) with the “magic triangle” at their core enriched by additional success criteria as identified in the literature review). The moderating variable “Project Management Approach” has been introduced to differentiate between the project approaches such as traditional Waterfall Models (e.g. Basic Waterfall model as described in section 2.1, et seq.), Agile project management approaches (e.g. Scrum as described in section 2.2 approaches, et seq.) and Hybrid models (as introduced in Chapter 4).

The situational context is introduced via the Cynefin framework to highlight the insights of contingency theory in the next section and represent how organisational forms, different behaviours of the organisational members (culture), the external and internal environment influence the project management outcome as well, due to differences in the situation in which companies find themselves.

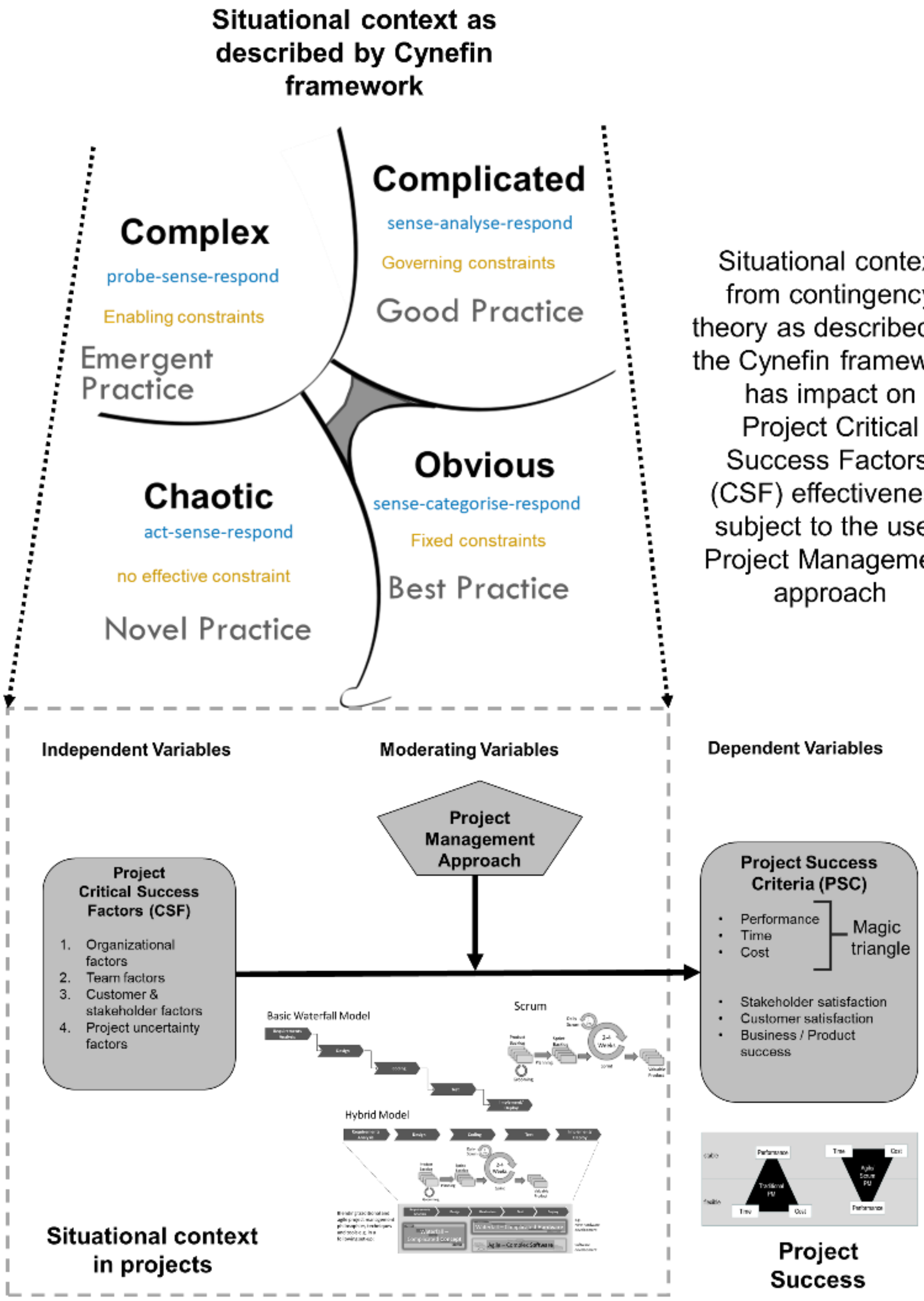


Figure 3.3: Contingency fit model of CSF for selection of project management approaches
Source: own representation

3.4 Using contingency theory: Cynefin framework applied in the project management context to describe various project situations

To facilitate the theoretical discussion, this chapter introduces the Cynefin framework (Snowden 2007, 2010). The author of the Cynefin framework is the Welsh researcher and consultant in knowledge management, David John Snowden. The Cynefin framework stems from knowledge management that is used to “describe problems, situations, and systems” (Snowden and Boone, 2007 and Snowden 2010). Cynefin is a Welsh word that is commonly translated into English as “habitat, haunt, usual abode” although this translation may not convey its full meaning (Cynefin Centre, 2019). By “Cynefin” Snowden means that there are so many interactions between individuals and their environment that a complete analytical description of a real system is impossible. A complete translation of the word would say that we all have several pasts that we can only be aware of in part. Certain aspects are available such as culture, religion, geography, phylogenetics and other elements.

The framework offers a classification of contexts that provides a direction and explanation of what kind of approaches and/or solutions to the problem should be chosen to address a given problem. Therefore, the framework is used to describe and identify situations based on their complexity. Snowden pointed out that Cynefin is actually a framework, not a model. A model aims at *representing* the world, whereas a framework aims at giving a *perspective* on the world (Cynefin Centre , 2019). Hence the term was chosen to demonstrate the rather metamorphic characteristics of complex systems and their inherent uncertainty: The term should remind the user of the framework in which human interactions are very much influenced by experiences (Snowden, 2007). Cynefin uses 5 domains for giving perspective and appropriate guidance for action which are discussed in the next section.

3.4.1 The original Cynefin Framework

The formation of the Cynefin framework suggests that it is based on research from the theory of complex adaptive systems, cognitive science, anthropology and narrative patterns, as well as evolutionary psychology (Kurtz and Snowden, 2003). It explores the relationship between people, experience and context and proposes new ways for communication, decision-making, policy-making and knowledge management in complex situations (Cynefin Centre , 2019). It is a framework which is used by decision makers to identify ("make sense") of a variety of business situations (McLeod and Childs, 2013). The Cynefin framework provides a typology of contexts that indicates what kind of explanations and/or solutions might apply. It investigates the relationship between people, context and experience in complex social environments (McLeod and Childs, 2013). Thus, Cynefin is about *understanding* situations or systems and reacting to them in the "right" way (Kurtz and Snowden, 2003). For project management this is important, since it gives us guidance when to use traditional and when to use agile project management approaches. For instance, of certain documentation requirements are necessary (e.g. for medical or in aviation projects, where traceability is important) the agile process model cannot sufficiently deliverer this requirement because the model inherently contradicts this assumption (Rüping, 2003). But when there is a high level of uncertainly and the solution is not known, planning becomes difficult and traditional project management cannot adequately deal with the dynamics of the required changes due to the rather stiff organisational structures (Wysocki, 2019).

The Cynefin framework has five domains and divides projects, tasks, or other generic problems into clusters; i.e. the basis of the Cynefin framework is a classification of perception into 5 fields (see also Figure 3.4), for each of which an action pattern is recommended, depending on the type of system. (Kurtz and Snowdon 2007, Snowden and Boone, 2007 and Berger and Johnston, 2015):

- Obvious/Clear (Simple), where the relationship between cause and effect is obvious to all. The approach here is: Sense – Categorise – Respond. We can apply best practice here. The simple range is characterized by the stability of the environment. Here it is easy to see which cause leads to which effect; the correct answer is obvious and is not in doubt.

- Complicated, where the cause and effect relationship require analysis, another form of assessment, and/or the application of expertise. Here Sense – Analyse – Respond can be used and good practice applies. Accordingly, the three-step procedure is simple: Sense – Analyse – Respond. First, the situation must be recognized, so as many facts as possible should be collected. Then the situation is categorized, that is to say, assigned to one of the many cases for which there are defined processes, and then it responds, by following the process. Actually, most situations are simple and fit in to this area. Often processes for doing so have been defined and best practices for following them been chosen. Little needs to be communicated and much can be delegated at the same time. The appropriate management style is "Oligarchic and consensual".

  While reducing complexity is fundamentally desirable, it sometimes leads to problems if it gets excessive. This can obscure the nature of things, decision makers become too comfortable and eventually overlook something. In such a situation it is not unusual for a system to quickly slide into chaos. Unfortunately, there is no easy path from chaos to simplicity, for previous processes need to be replaced and new processes developed. It is important to note that the path from Chaos to Easy usually leads through the steps of complex and complicated. This is discussed next.
- Complex, in which the relationship between cause and effect can only be perceived with hindsight. Here the Probe – Sense – Respond approach is best and emergent practice can be identified.

  In contrast to the previous cases, in this the best-fit solution can no longer be derived in advance. This is the most common situation when working in the area of knowledge and creativity.

  Cause and effect can be recognized only with hindsight. However, it is possible to recognize patterns, making small experiments, which can cause no major damage, appropriate. This is why Probe (=Trying out) – Recognizing – Reacting is needed here.

  This method will result in the correct solution being gradually developed in small, iterative steps, without knowing in advance exactly where the journey will end. This is very similar to the concept behind Scrum, and indeed, it is believed that in such an environment agility can deliver the most value (Boehm and Turner 2004).

- Chaotic, in which there is no relationship between cause and effect at the systemic level. Here the recommended decision-making directive is Act – Sense – Respond. The advantage of a chaotic environment is the higher likelihood it offers of discovering innovative practices. In a chaotic environment, cause and effect cannot be recognized even with hindsight because no patterns can be discerned. As a consequence, looking for a sustainable pattern which would enable decision makers to make the right decision would be a waste of time. Something must be done first to eliminate the biggest problem. Then one has to recognize which action has brought stability to the situation, followed by a reaction with the aim of ending the chaos and transforming the situation from a chaos into a complex situation.

  A chaotic situation has many disadvantages. One of them is that there is no time for input from others to stabilize the situation, e.g. there is simply no time for democracy in the form of discussion or for co-determination. Above all, action must be taken and communicated swiftly to stabilize the situation. Hence, according to Snowden, the top-down approach actually works best. Unfortunately, the top-down approach in the other situations, especially in complex situations, is precisely the worst and most adverse strategy. Therefore, the transition from chaotic to complex situations using top-down strategy requires another change for the organisation's management and its style before a complex situation can be successfully managed. This rather abrupt change is not easy to achieve in organisations and is often the source of failure.

  But chaos also has a clear advantage: in chaotic situations, new, innovative solutions are generated and are more likely to be accepted and hence chaos is the best, most fertile ground for creativity. A strategy suggested by the theory is to name two teams in the event of chaos: one to fight the crisis, and one to look for opportunities for innovation (Kurtz and Snowden, 2003).
- Disorder, the state of not knowing what kind of causality exists. In this situation people go back to their own comfort zone when they make a decision. Used in full, Cynefin has sub-domains, and the boundary between "simple" and "chaotic" is seen as catastrophic: complacency leads to failure and "applies when it is unclear which of the other four contexts is predominant" (Snowden and Boone, 2007, p. 69-70).

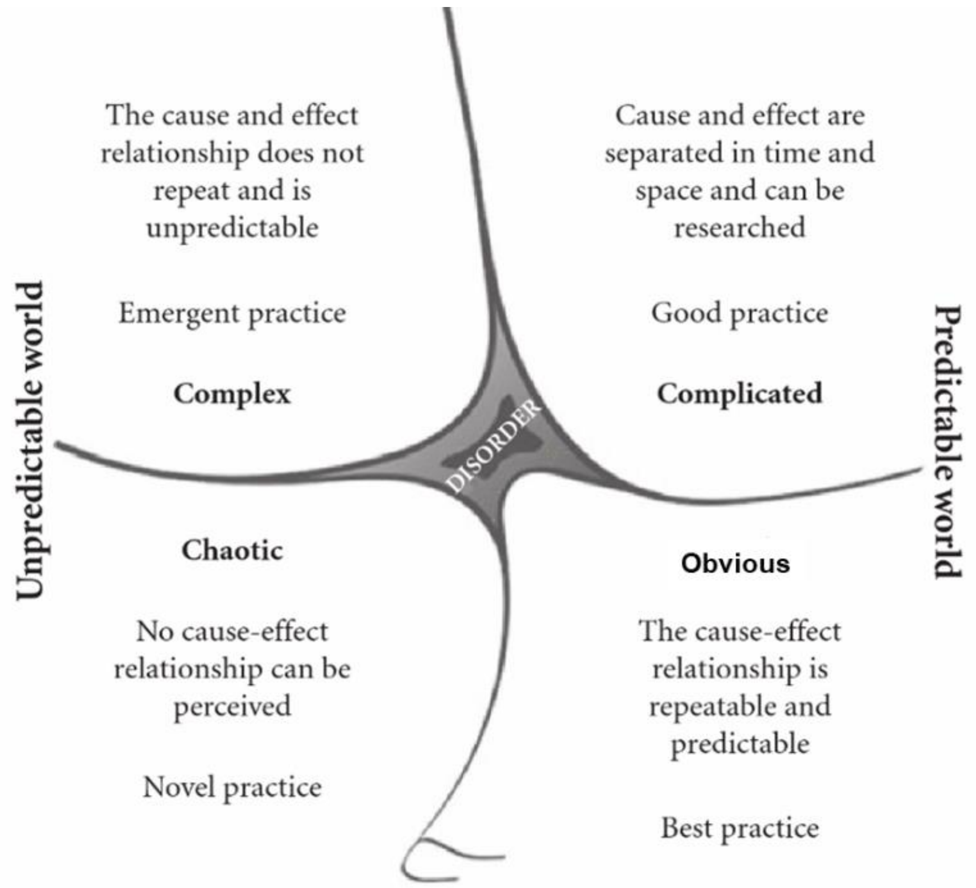


Figure 3.4: Cynefin Framework
Source: adapted from Berger and Johnston (2015), p. 44

As we have seen, the Cynefin Framework gives "recommended courses of action" which when applied correctly allow for a high success rate for the given situation. In particular, the distinction between "complicated" and "complex" shows clear difference in applying an effective decision-making strategy. Complicated environments require decisions and interactions which are very wide-ranging and multifaceted but can be handled with a reproducible and deterministic decision-making approach. Generally, technical systems, such as a computer system are considered "merely" complicated, but not "complex", while social systems especially in the area of change and project management are generally considered "complex". Thus, in a social system such as a transformational project in an organisation, project management approaches should be adjusted to the situation and to the habitual environment. A summary of the findings is presented in Table 3.3.

The five domains are summarized in the Table 3.3:

Table 3.3: Summary description of the five Cynefin domains. Source: Adapted from McLeod and Childs (2013), Snowden and Boone, 2007, own deliberations

	Obvious / Clear (former Simple)	Complicated	Complex	Chaotic	Disorder
Characteristics	Ordered, stable, repeatable: Clear cause and effect, evident to everyone what is the right answer	Ordered, stable, discoverable Cause and effect not evident to everyone, More than one right answer	Un-ordered, fluid, unpredictable, Cause and effect seen in retrospect, not in advance An answer/solution may exist but is unknown	Un-ordered No clear cause and effect No right answer/solution	Turbulent No clear cause and effect Interim state with no direction
Comprehension	Known knowns	Known unknowns	Unknown Knowns	Unknown Knowns	Unknown Knowns
Decision model	Sense►Categorize► Respond	Sense►Analyse► Respond	Probe►Sense►Respond	Act►Sense►Respond	Sense ► Analyse ► Move to one of the four domains
Resultant action techniques	Best practice	Good practice	Emergent practice	Novel practice	Decide which of the other four domains should apply
Techniques	Standard operation procedures Process reengineering	Scenario planning Business intelligence Systems/Design Thinking	Emergent practice Complex adaptive Systems/Design Thinking	Novel practice Crisis management	Chaos management
Work patterns & cooperation	Co-ordination Strong connects between the managers and the employees Weak connections between employees	Co-operation Strong connection between the managers and the employees Strong connections/networks between individuals/experts	Collaboration Weak connects between the managers and the workers Strong connections/networks between individual employees	Directive interventions Weak/no connections between managers and employees; weak/no connections between the individual employees	Directive intervention
Management style	Hierarchical and directive	Oligarchic and consensual	Informational and consensual	Decisive and directive	Decisive and directive

.

3.4.2 The liminal Cynefin Framework

In July 2017 Dave Snowden started to extend his Cynefin Framework. The main categories of his five constructs in the form of “domains” still exist, but the way that situations shift from one domain to another has been refined. A change in the domains is called a “dynamic” and Snowden admits that the change between the domains has often been neglected (Snowden 2017a and 2017b).

During the teaching of the Cynefin Framework it became evident that the boundary zones in particular have never been discussed at great length; hence, “liminal thinking” has been recently added to the framework.

Figure 3.5: Liminal Cynefin (Source: Snowden 2017a and 2017b)

The reason why Snowden has enhanced the existing Cynefin framework is as follows: “So in effect I am creating two shadow domains to add to the existing five, but by making them liminal areas of transition I can draw on a wider body of literature and increase the range of ideas and concepts that contribute to the overall fractality, or multi-layered discovery that is one of the features of Cynefin." (Snowden 2017c).

The phrase "liminal Cynefin" is used according to the original Latin root, meaning "a threshold state; a sense of being in a state of tension during transition. Cynefin assumes a phase shift between the ontological states of order, complexity and chaos, unlike some people in the field I don't see it as a spectrum or gradient, but a clear boundary" (Snowden 2017a). Hence the Cynefin Framework has been enhanced by a liminal line connecting complicated, complex, chaos and disorder dimensions (see the green line, 1, in Figure 3.5).

In practice, users of the Cynefin Framework seem to have difficulties with the dynamics in classifying the context of situations. One example is Snowdon's description of managers applying Scrum. He states that when project management situations move from the borderline of complicated to complex, many "project managers get confused" over what it means to adjust the project management approach (Snowden, 2019). This observation was a starting point for Snowden to rethink Cynefin and to introduce the liminal areas in the framework. Liminality is a term coined by the ethnologist Victor Turner. It describes a threshold state in which individuals or groups find themselves after they have ritually detached themselves from the dominant social order (Turner, 1974). Turner distinguishes three phases in a rite of passage: the separation, the threshold and the affiliation phase. Liminality is in the second phase, the threshold state. Examples are the initiation rites of archaic societies or revolutions of industrialized or modern societies. During the liminal phase, individuals are in an ambiguous state, when the classification system of the everyday social structure has been abolished (Turner, 1974). The disintegration of order during liminality results in an unstable state or condition that enables emerging structures to establish themselves (Horvath et al., 2009).

Snowden states that similar liminal situations can be observed in project management situations.

According to him (2017b) the Cynefin framework has areas of state change. Some of these are regular changes, while others are liminal:

1. Between obvious and chaotic is considered to be a "cliff" as defined in the original Cynefin framework (see Figure 3.6 (1)), representing turbulent, no clear cause and effect situations. It is a non-liminal interim state with no direction.

2. Form obvious to complicated is an overlay based on human perception which, unlike all the other boundaries in Cynefin, does **not** represent a liminal phase shift but is an important shift between domains and for project management because it increases uncertainty and therefore requires regular reviews and adjustments in project management plans and approaches (see Figure 3.6 (2)).
3. From the border between complicated and complex, there is a **liminal area** beside a complex area (see Figure 3.6 (3). In this situation the right approach is a period of experimentation (e.g. pilots, prototypes and iterative developments). For instance, in Scrum project management and other agile approaches it is realized by iterations of sprints. Snowden (2017b) calls this "a state of suspension, of holding options open for as long as possible" to describe the best fit strategy in this kind of situation. As a result, the liminal Cynefin framework was enriched with additional sub-space for the recently available agile techniques, which belong to the complex domain with a boundary to the complicated. The remaining complex domain in the liminal Cynefin represented without the liminal area now represents greater levels of uncertainly. The right approach in this situation is "early stage exploration, unarticulated need emergence, parallel safe to fail experiments" (Snowden, 2017b). As a result, there is a significant difference in the representation of ambiguity and the finding of stability between the main domain and the new liminal category bordering complex and complicated domains.
4. There are many situations in the complicated domain, which in project management remain mainly in the complicated area, but here and there are situations when work gets into the Complex domain for one identified temporary issue or problem (see Figure 3.6 (4)). Snowden (2017b) advises in such situations to apply "parallel, low cost safe-to-fail experiments in parallel to a more linear and focused attempt to change the nature of constraints to allow increasing control and predictability". In Scrum project management terms this translates into using multiple parallel sprints and retrospectives to determine the right direction, approach and finally a solution. The approach of not planning for a solution but using parallel experiments (fail fast, learn fast, adjust direction) is a novelty in project management and requires a cultural change in organisations because failure will be part of decision making which implies a significant shift away from traditional project management decision making.
5. Furthermore, Snowden adds a new liminal state between the chaos domain and the complex domain (see Figure 3.6 (5)). The new areas allow trespassing from the

complex domain. In these areas innovations can be identified; "all effective constraints are abandoned to allow novelty to emerge" (Snowden, 2017b). Work is done in a distributed organisation with distributed intelligence, and the wisdom of crowds within these systems (Snowden, 2019). Such situations are characterized by zero constraints, but also by little connectivity between groups. This implies that much effort is required to maintain this situation but it also creates space for novelty and unusual problem-solving approaches.

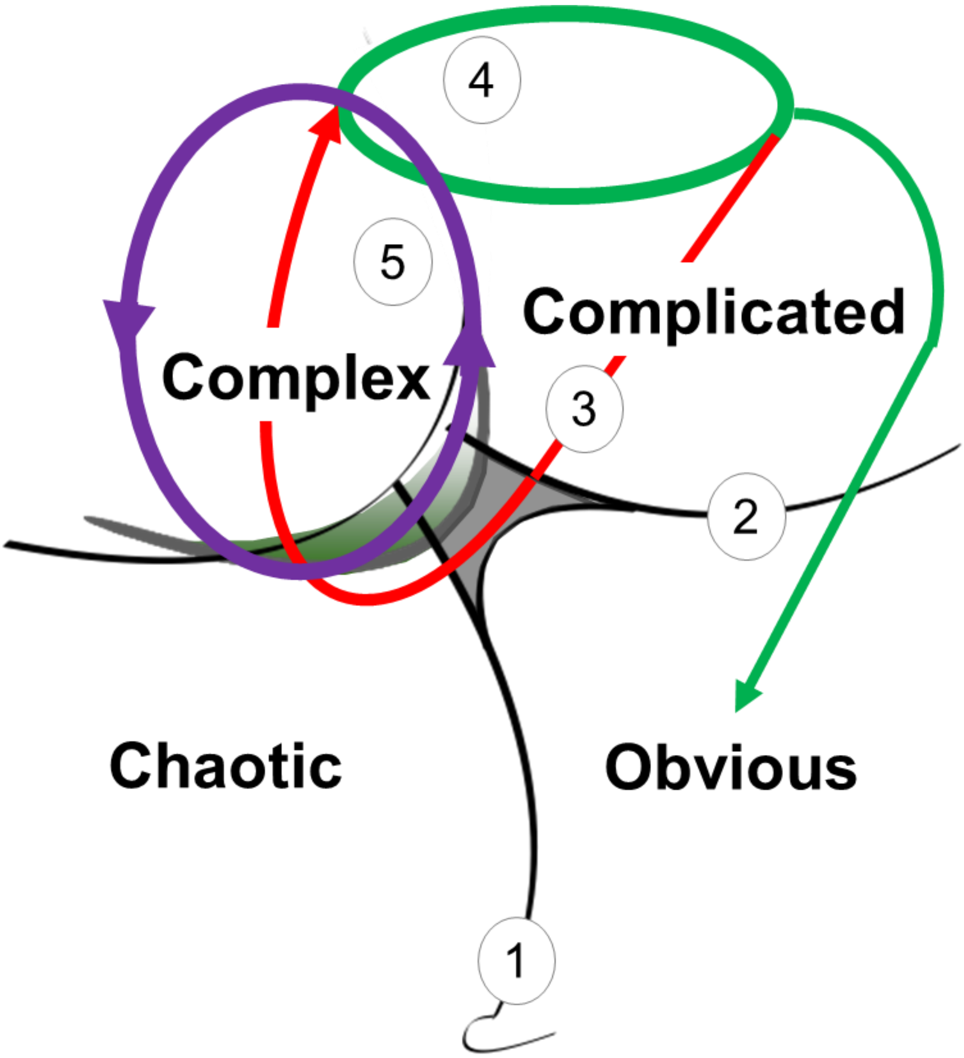


Figure 3.6: Liminal Cynefin (Source: Snowden 2017a,b)

During the development of the enhanced liminal Cynefin framework, Snowden notes (Snowden 2017b) that a major liminal line needs to cut across the disorder domain. It can then create a "domain of transition, while the rest is an inauthentic state of confusion. In the former we know what we don't know, in the latter we don't know what we don't know" (Snowden 2017b). This is a significant finding for project management: if we know that we don’t know we can use experiments to manage uncertainty. If we don’t know that we don’t know, project managers fall into the trap of trying to create unsuitable assumptions on which project planning is based, not knowing that this plan is not robust enough to carry out any project work. This is thus a regular root cause of project failure and needs to be detected in situational hybrid project management

As we have seen, the Cynefin Framework gives us valuable inputs and guidance to change the project management approach for the best decision making in varying environments. This is a very valuable input and forms the framework needed for the development of a hybrid project management approach in this research. This is presented in the next Chapter 4 with the introduction to Hybrid Project Management.

4. Hybrid Project Management

Chapter 2 highlighted traditional and agile project management and Chapter 3 looked at the more recent enhanced academic discussion on project management. Chapter 3 introduced the theoretical concept of CSF and contingency theory which gives us insights for adjusting decision making depending on the situation (a simple, complicated, complex or chaotic environment). Based on the insights of complexity theory, section 4.3 focuses on when to use traditional and when to use agile project management with a view to a hybrid project management model. First, it introduces hybrid project management and shows how hybrid project management can be achieved by suitable sequencing deliberations. This is followed by a discussion on the selection of a hybrid set-up, using insights from the Cynefin matrix with the Project Management Life Cycle (PMLC). By using insights and applying this decision-making model we can propose a framework for hybrid project management decisions.

4.1 Introduction to Hybrid Project Management

Agile approaches lead to major challenges for organisations because they abandon conventional project management methods and roles; there is no "one-size-fits-all" form of project management nor a "Silver Bullet" for using agile approaches (West et al., 2011). Nonetheless, as organisations increase in size, the tendency to formalize rules and policies increases (e.g. project approvals, time management), which may erode the required flexibility (Cottmeyer, 2014). In addition, project managers in organisations take various approaches to the multiple challenges of managing projects, not only in software development but also, for example, in delivering new HR grading approaches. They seldom implement a project approach purely "by the book". Thus, project managers seek adequate project management approaches, yet face a "huge variety of contextual factors influencing the use of project management methods" (West et al., 2011). To address these challenges as well as the growing number of areas in which project management is an important aspect of managing change, methods other than pure Waterfall and agile have been suggested (Kerzner 2014). These methods reveal different outlooks: they may combine stage phase project management methods with agile principles, as described above. The challenge for project managers is to select the *best fit method*, which not only fits the project goal and problem but also fits the *external and internal environment* of the organisation in which the project is embedded.

The following graphic, Figure 4.1, represents the generic integration of these models and a definition of hybrid project management:

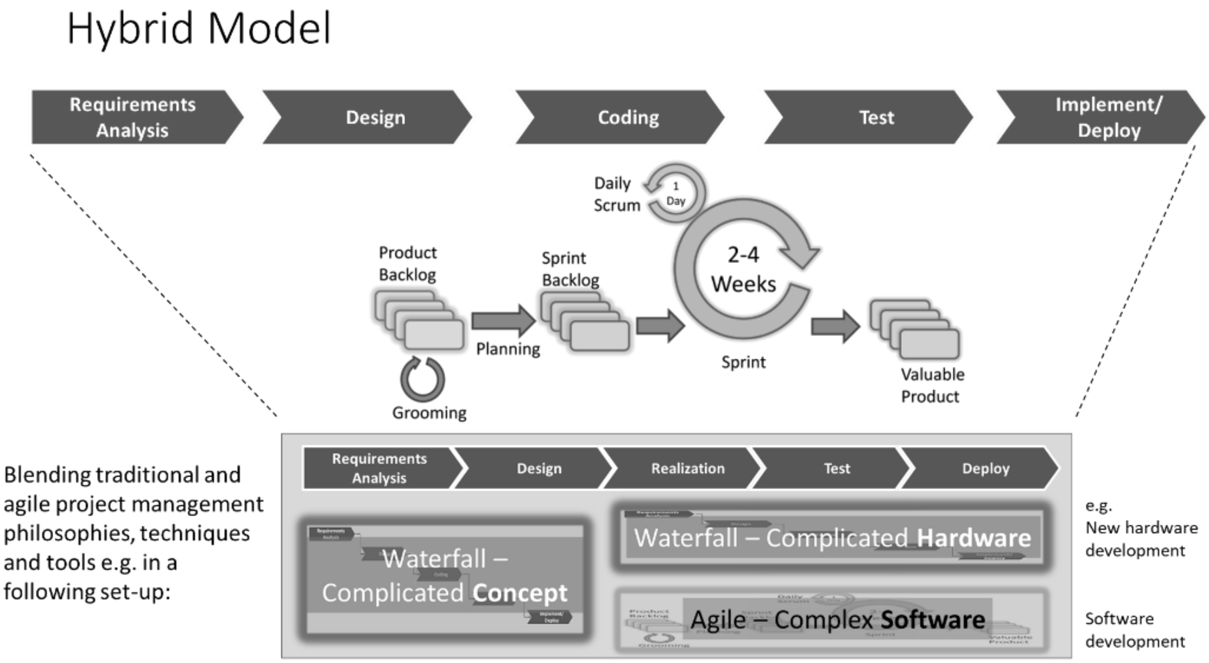


Figure 4.1: Development of a Hybrid Project Management Approach
Source: Own representation, scrum model adapted from Sami (2012)

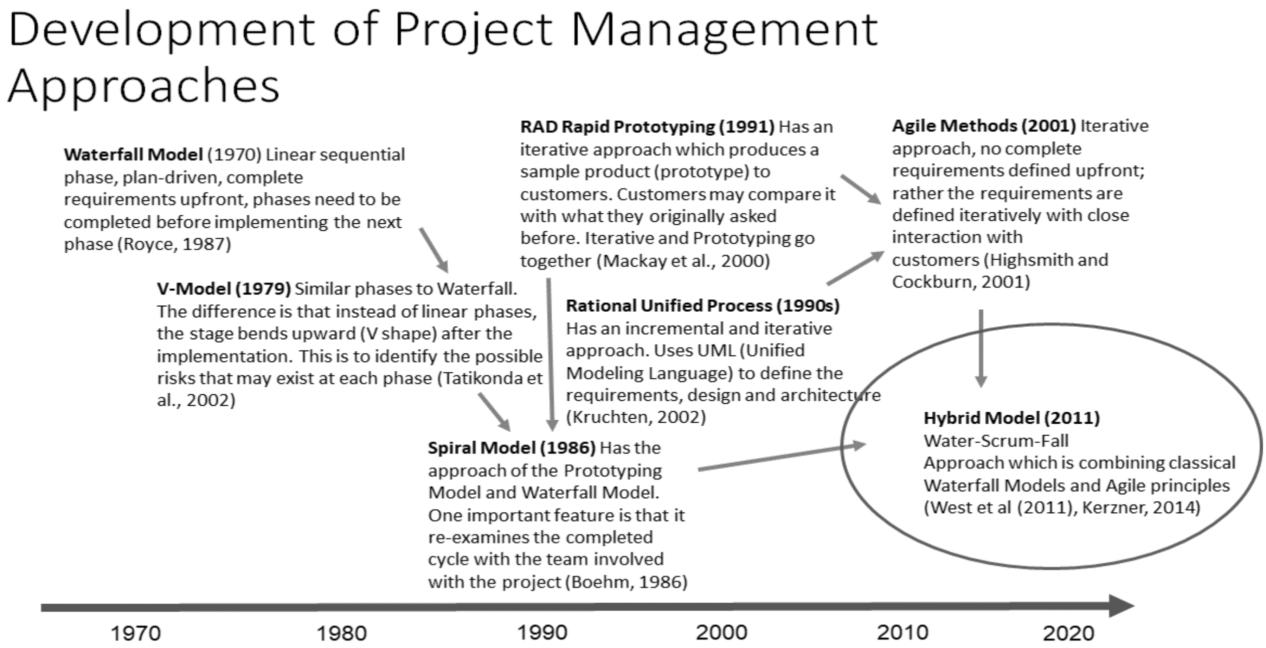


Figure 4.2: Development of a Hybrid Project Management Approach relative to other project management approaches, Sources: adapted from West et al. (2011), Kerzner (2014), own representation

For this dissertation, the definition of Timinger and Seel (2016) of hybrid project management was selected:

When two or more different project management models are combined, Hybrid Project Management is established. Hybrid project management refers to the use of methods, roles, processes and phases of different standards or process models[5].

This research is anticipated to add to the body of project management knowledge comparing traditional and agile project management approaches and enquiring when to use which available paradigm. With this the use of good practices can be combined to construct a hybrid project management model (see also Figure 4.2). This also adds to project management theory, based on the Cynefin framework, giving insights for using paradigms derived from situational factors.

The classifications in this model and its underlying theory are proposed for identifying when and for which task a particular project management approach should be chosen. In the proposed hybrid project management model, the project management approaches should not be considered mutually exclusive but rather understood as complementary and mutually supportive tools. In addition, the choice of project management methodology from traditional to agile should be seen in a context driven, continuous approach, i.e. there is no single point in decision making by which to determine which project management approach to use. For instance, when requirements are quite clear at the beginning of the project and the activities can be determined rather easily, a Waterfall approach is probably the best fit for the task or sub-task at the time (an obvious domain in the Cynefin framework). However, when only a vision has been agreed on and no consensus reached on what the target solution could look like or how it could be organised, it is likely that agile project management would be the more successful approach (complicated domain possibly bordering on the complex domain).

[5] To give a better practical illustration of hybrid project management, a project may be traditionally organised according to the waterfall model. If a sub-project is carried out in an agile way, for example with Scrum or Kanban, then it exemplifies hybrid project or program management.

4.2 Development of a process model for successful hybrid project management

In Chapter 2 traditional and agile process models were discussed. Whenever two or more different process models are interconnected, so-called hybrid process models are established. This section asks how hybrid project management could be formed in more specific terms and how it might be designed. Timinger (2017) established thee main integrative approaches leading to the establishment of a hybrid project management framework:
Before discussing further examples of hybrid projects, the combinatorics for defining hybrid approaches should first be considered

1. By **sequential** application of different process models: Thus, in the context of a construction project, the planning phase can be carried out with an agile approach using Scrum and the subsequent construction phase can be processed according to the traditional Waterfall model.
2. By **parallel** use of different procedure models: An example is a software development project, which is carried out as a whole on the traditional Waterfall model. One or more subprojects are processed with Kanban in parallel to deliver the software development of the product.
3. Through the **integrated** application of various process models: In a project traditionally carried out according to the Waterfall model, a Kanban board is used for planning and controlling the activities and the project is controlled by bi-weekly brief discussions (similar to a sprint retrospective). These are reviewed below.

4.2.1 Sequential integration

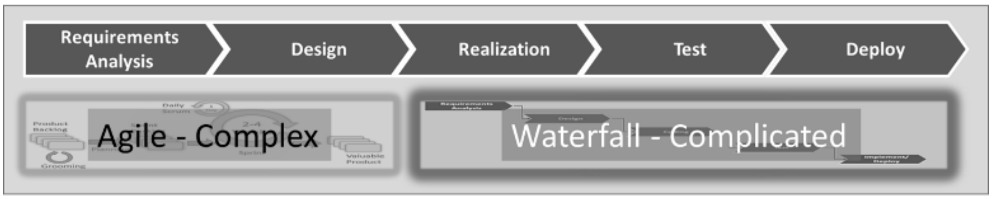


Figure 4.3: Sequential integration

In section 2.1 and 2.2 traditional and agile process models were reviewed. This and the following sections deal with possible combinations of traditional and agile process models. There are many organisational situations where it is wise to use both traditional and agile components to reach a best fit.

One combinatory example could be the sequential integration of traditional and agile approaches.

For instance, the standard approach to development projects provides an introductory concept or feasibility phase. With this approach, for example, prototypes are designed and evaluated, so that as many risks and unknowns as possible can be identified for a later implementation of the product. The project deliverables usually consist of hardware and software components; Hardware components can be changed only with some difficulty and significant expense. Therefore engineers quite often hesitate to carry out the development according to the pure agile procedure models. Instead, the roll-out adopts the Waterfall model on the hardware side because many interdependency risks have been identified in the requirements and design phase. However, a sub-project on the software side which could for instance, use Scrum to develop the supporting software components. Due to the better integration of the customer with other stakeholders (one of the benefits of a scrum model), many stakeholder and user(s) risks can be identified and the initially volatile (unclear) requirements can be substantiated to the point where the later roll-out and the required interfaces to the respective hardware is relatively predictable. As an example, in the researcher’s company the decision was made to embark on a HR transformation. This included the implementation not only of a new HR structure but also a new HRIT system. Many group-companies have their own HR structures and legacy systems, so the agreement on a single delivery model was complex and politically challenging. In this case it was rational to develop and design the HRIT system in an agile way since many changes and feedback loops were necessary. At a later stage, when the roll-out to the group companies took place, the focus shifted from interaction of customer feedback to the delivery of the developed solution. Here the traditional project management approach is preferred, because the delivery of the HRIT system on time was the main concern, with a pre-defined scope (as validated in the previous development using Scrum as project approach). The example already shows a distinct feature: upfront agile process models can be used to reduce the risk of delivering an unaccepted or unfit product. This risk of unfit solutions should be reduced via agile project management approaches to ensure that it does not show up at a later implementation. Such a project situation might have been executed with the traditional project procedural model as well, however the risk of an unfit solution would be hidden until the end of the project. A sequential arrangement also makes the combination of two or more process models comparatively simple. One prerequisite is however the management of respective interfaces, so that results of one sub-project are interlinked with the other sub-projects or tasks, which must be clearly defined.

Another practical example on the usage of sequential integration originates from a construction project setting: In this example agile project management is used in search of an optimal interior design: Before the final interior design for e.g. 300 new office rooms are specified, 3 different type of designs are tested in a save-to-fail experiment[6] and used with an agile product backlog within multiple sprints.

Only after the design has been successfully tested, the rest of the 297 rooms are created with traditional project management practises.

An example is shown in Figure 4.3, above.

[6] Safe-to-fail experiments are small-scale experiments that approach issues from different angles, in small and safe-to-fail ways, the intent of which is to approach issues in small, contained ways to allow emergent possibilities to become more visible (Snowden, 2019).

4.2.2 Parallel integration

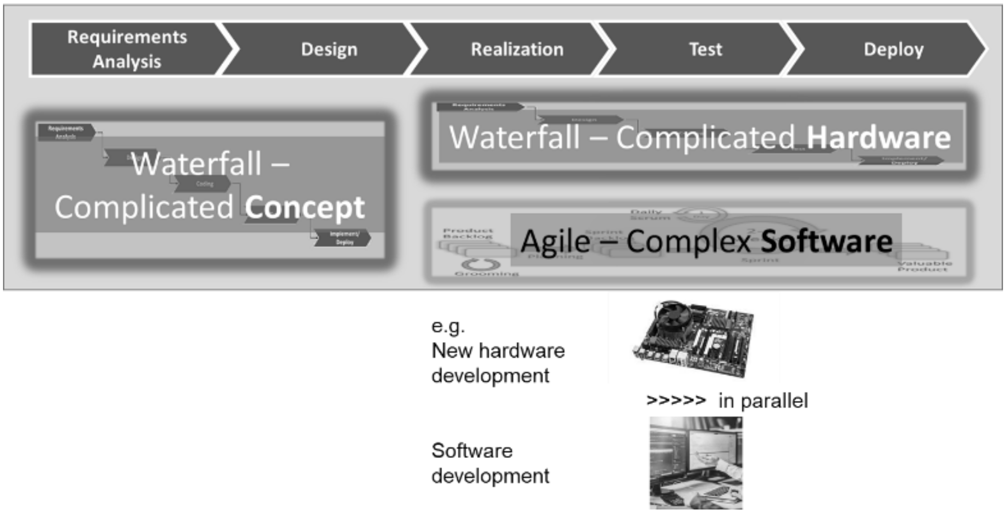


Figure 4.4: Parallel integration

Traditional and agile process models are not limited to sequential application, i.e. one after another. They can also be simultaneous, i.e. run in parallel, within a project. Thus, for example, different characteristics of sub-projects can be taken into account (see Figure 4.4).

A large mobile development project is traditionally carried out according to the Waterfall model.

Many components of the project object can be well specified (e.g. the hardware of the mobile like CPU, network capability, external interface) and its requirements are largely stable. In addition, not all components can be changed easily. The software sub-project is run in an agile way using Scrum. Here the requirements may be much more volatile. The software is readily changeable. The situation sketched in the example is typical for the use of hybrid process models with parallel application of agile and traditional project management. Nevertheless, there are other options, such as

- Agile overall projects with traditional sub-projects
- Agile or traditional projects where one supplier works according to the other's procedure model

Unlike the sequential application of traditional and agile process models, parallel application uses traditional and agile processes, methods and roles concurrently. In order to achieve project success, the defined overall project object must be defined. For the development, synchronization points are required over the entire project lifecycle (here, hardware vs. software), so that all the components of the project object fit together in terms of time and content. This presents a special challenge for project planning (e.g. via a project management office), since different processes, methods and roles have to be synchronized.

Another practical example on the usage of parallel integration comes from a car manufacturing project setting: Here the design of the battery hardware components are done with traditional project management and the design of the battery loading approach (with a large software development component) is completed in an agile project management setting.

4.2.3 Fully integrated application of various process models and tools

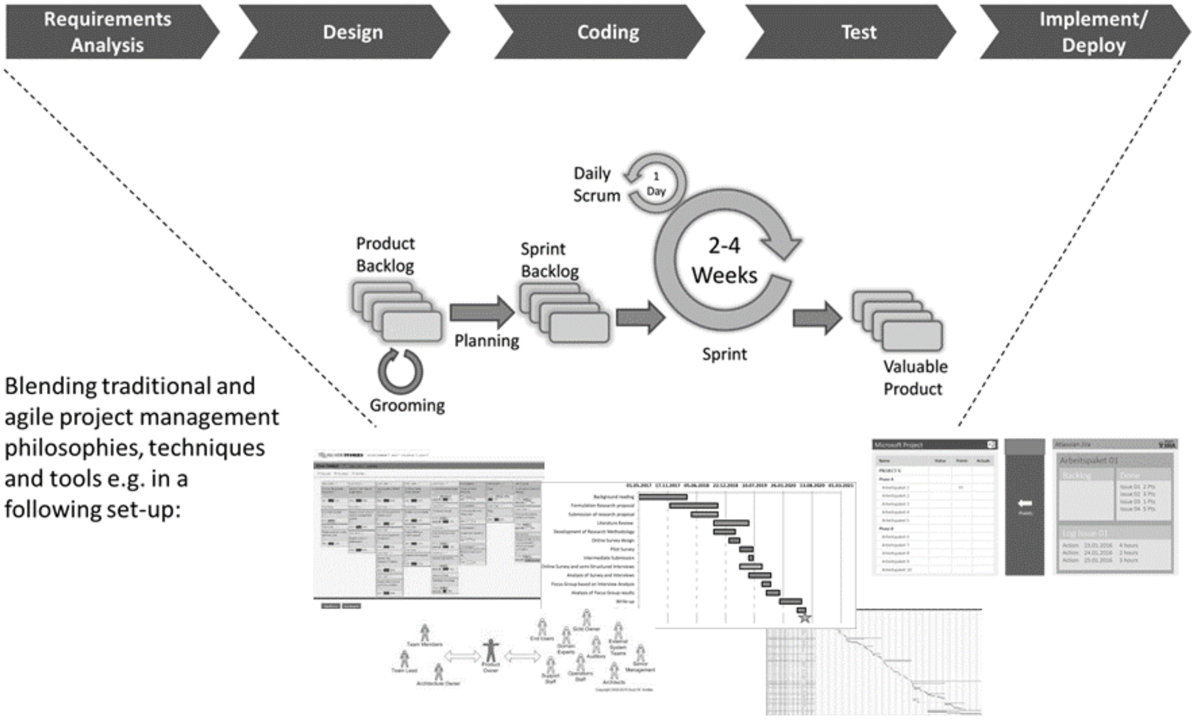


Figure 4.5: Fully integrated application of various process models and tools

With the integrated application of traditional and agile process models in hybrid projects, traditional and agile processes, methods and roles cannot be assigned to temporal phases (as in sequential applications) or to subprojects (as in parallel application). Instead, these processes, methods, and roles are used and blended along the project lifecycle. This can be done used in many ways and approaches (Timinger, 2017). The following examples illustrate how traditional and agile project management can be blended (see also Figure 4.5). The idea is that a set of project management philosophies, techniques and tools are used and applied situationally i.e. on an “as needed” or “as considered appropriate” basis.

Table 4.1 Examples of hybrid project management combination patterns

	Practical example
Traditional Waterfall model is enriched by agile tools	The integrated application of traditional and agile process models can be achieved if a project manager is managing a project that follows the traditional Waterfall model to manage the project life cycle. However, to manage project tasks, a Kanban board is used on which the project tasks are prioritized according to the Waterfall phase-gates. The team mainly follows a traditional process model but autonomously manages the project tasks and delivers these with a rapid and flexible response to change as in agile projects using the agile tools. Example: A Kanban tool (e.g. Jira) is used to manage all tasks from the project management plan to create and track daily project activities.
An agile project is enriched by traditional methods	In a Scrum-based project, instead of using user stories and story points, conventional requirements and effort in person-days are used in order to work better with other stakeholders such as external vendors. Example: Project team uses story points for daily sprint planning and person-days for management reporting.
Traditional V-model is enriched by agile philosophies and ways of working	A company might use this if it traditionally works according to the V-model and has not had any previous experience with agile project management but would like to transition towards a more agile way of working. For this purpose, agile processes and methods are included in the traditional V-model: customer reviews and retrospectives are integrated into the individual development cycles. The teams are allowed to self-administer the tasks they want to work on. Example: The weekly project meetings are replaced by daily briefings inspired by the Daily Scrums.
An agile project is enriched by traditional ways of working	An agile Lean sub-project might report its weekly and monthly project status to an overall traditionally managed program. Example: Agile practise incorporated in traditional project set-up for status reports.

The examples above (see table 4.1) are of course not comprehensive due to the sheer number of possible combinations. However, the examples show that the traditional and agile process models can be integrated in completely different line-ups and options, allowing **adjustment to individual situations** (according to contingency theory using the Cynefin framework; see also sections 3.3 and 3.4). Often, it is company-specific framework conditions that make the implementation of purely traditional or agile procedure models difficult. These include, for example, company policies, company culture, regulatory and legal requirements for project implementations (such as contractually agreed interfaces to clients or suppliers). In order to use hybrid models the employees on both traditional and agile project management approaches need also to be highly qualified. Quite often irreconcilable ideological disputes (e.g. Generation X employees, who grew up under the traditional project management paradigm, struggle with Millennials, who started in project management when agile project management was the only option) may make it difficult to accept the way that the other side works.

A benefit for the integrated use of traditional and agile process models is the desire to combine the advantages of both approaches and at the same time to minimize their disadvantages as much as possible.

Currently the agile way of working has a positive connotation especially among Millennials, which has a motivating effect on many employees (Alton, 2017 and IPMA, 2017). Traditional ways of working seem to be less attractive for younger project managers because autocratic, hierarchical organisational structures are perceived as old style "command and control" ways of working (Hatum, 2013). For this reason, many companies in recent years have wanted to develop into agile organisations with a modern, innovative look. Traditional processes are broken up and agile thought patterns, methods and roles are introduced.

As part of a company-wide hybrid process model, traditional and agile process models can be integrated; individual projects too can also benefit from hybrid approaches. Many project managers use agile approaches within the company's process models to motivate their employees to engage customers and manage the project. The delegation of tasks, self-determination, good feedback culture and communication as well as the transparent assessment of progress are only a few key points that make for an agile character in traditional projects.

In practice, it is therefore not enough to design process models as hybrid. The understanding of leadership has to be adapted to the approach in the project and the people working in it: a modern understanding of leadership puts people at the centre and orientates them to their abilities. In many situations agile values and principles can form a basis for leadership (Timinger, 2017).

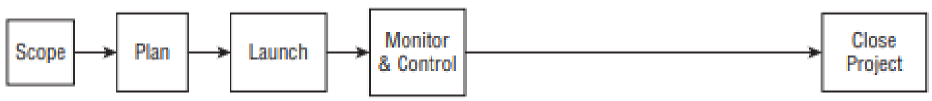
Traditional as well as agile process models have shown that projects carried out by them can be successful and that they are considered to be legitimate representatives of efficient and effective project management. Hybrid process models try to adapt traditional and agile process models to framework conditions and to further optimize them to reap more benefit using the individual strength of each. However, an unstructured mix of traditional and agile process models will not always result in benefits.

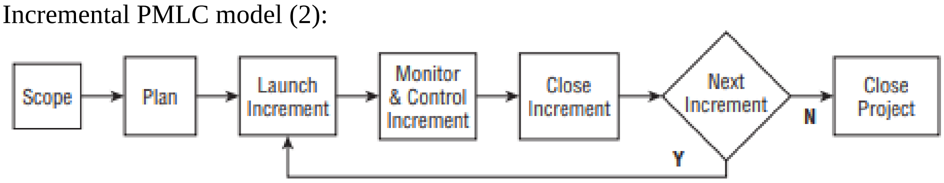
4.3 Selection of hybrid models

Standards and procedural models are important; they help us with project development and orientation. We use these to guide us in on doing “the right thing” (= good practice) at the right time. Standards and standardized process models also help us to define company-specific project processes and structures. If each project is handled differently within an organisation, it will be more difficult to scale successes and avoid failures in subsequent projects. The use of project management standards that work towards the establishment of a hybrid project management framework can be considered a critical success factor in itself. But if a standard does not fit the company and its way of working, problems could multiply as project management becomes more inefficient and ineffective (Timinger 2017). For instance, the chosen approach might not fit the company culture and the way of decision making or stakeholder integration. Organisational frictions might lead to unnecessary disputes delaying decisions and activities. If a standard which does not fit is chosen for the entire organisation, then all projects are subject to this inadequate project management approach, risking the capacity of the entire organisation to adjust by means of projects. Hence in choosing the right project management approach the cultural fit is an important aspect to include.

Standards and procedural models should not be adopted without thinking. Companies often implement new project management approaches and use “out of the box” ideas or are trained by external consultants. Later the company’s project managers will be asked to use this project management approach and its toolkits, although they do not fit the situation and thus produce sub-optimal results. A premature application of new project management models may also affect the entire company’s capacity to change. For instance, Agile project management is considered flexible, customer-oriented and a good fit to our VUCA world paradigm. However, it may not fit all aspects of the company’s environment and every project problem. For instance, the development of an insurance backend system has to serve many different front-office systems with various interfaces and different requirements. To build up a system which is the foundation for many other systems can be highly complex and decisions taken in the project may have long-term effects on subsequent interfaces and other projects. An agile approach might not take these long-term architectural topics into account because it focuses on current customer needs (not on possible future needs). Thus, the selection of the project management approach may affect the long-term critical success factors of the project or product. In addition, an unintentional change from traditional to agile project management can fail because it ignores stakeholders. Good change management is therefore important. The selection of a suitable project management model is demanding and depends on many criteria (Timinger 2017), as the previous example makes clear. A quick initial decision on one project management model may take into account only a fraction of the relevant information or neglect opportunities to adapt and design hybrid process models. It is therefore important to remain open to changing the project management approach over the life-cycle of large projects and entire companies, as Neve et al. (2017) show. However, little is known about what makes this approach successful, although Wysocki (2014) has proposed using the process models according to the level of certainty of the goals and the solutions. Wysocki summarizes this in his life-cycle models, as shown in Figure 4.6 (Wysocki 2014, pp. 45-54):

<table>
<tr>
<td>Traditional

For obvious/simple and complicated situations</td>
<td>Sequential/Linear PMLC model (1):


Incremental PMLC model (2):

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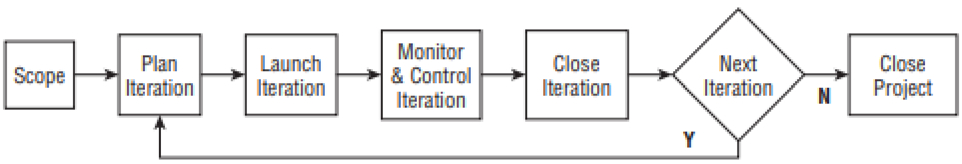
<tr>
<td>Agile

For complicated and complex situations</td>
<td>Iterative PMLC model (3):


Adaptive PMLC model (4):</td>
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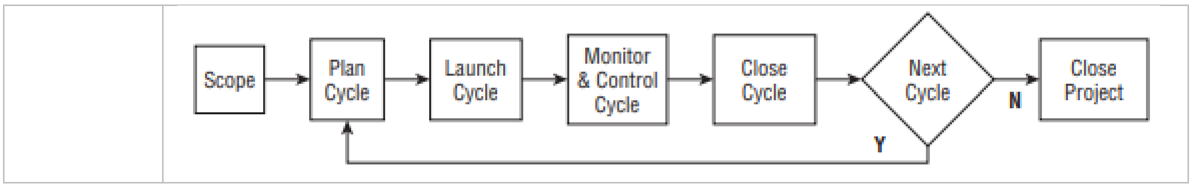


Figure 4.6: Traditional vs. Agile Project Management Life Cycle models (PMLC)
Source: adapted from Wysocki (2014)

Traditional projects define goals and map the future in plans which are then followed by a step by step (Linear PMLC) model or in incremental steps (in the Incremental PMLC model) until the planned project object is created. Agile projects plan iteratively, and thus in small steps (in the Iterative PMLC model). Next, the planned step is processed and the next step is planned until the entire project object has been completed by iterations. Alternatively, the project can be broken down into phases (in the Adaptive PMLC model) and a specific goal can be defined for each phase and plans for it can be drawn up. The project object is then completed in phases of cycles. In agile process models, planning is always iterative and in small steps. The entire project is planned, if at all, only very roughly or at a high level. A detailed plan is available only for the near future. In an extremely agile variant (the Adaptive PMLC model in Figure 4.6) even the project goals are iteratively adjusted or more detailed. Agile action as such is therefore not considered to be planned. In their implementation projects have great flexibility to optimize the project subject in the sense of customer requirements.

Schemes to support selection can be combined with complexity theory. This is as shown in Figure 4.7 and gives guidance on when to use what kind of project management life cycle (PMLC) model:

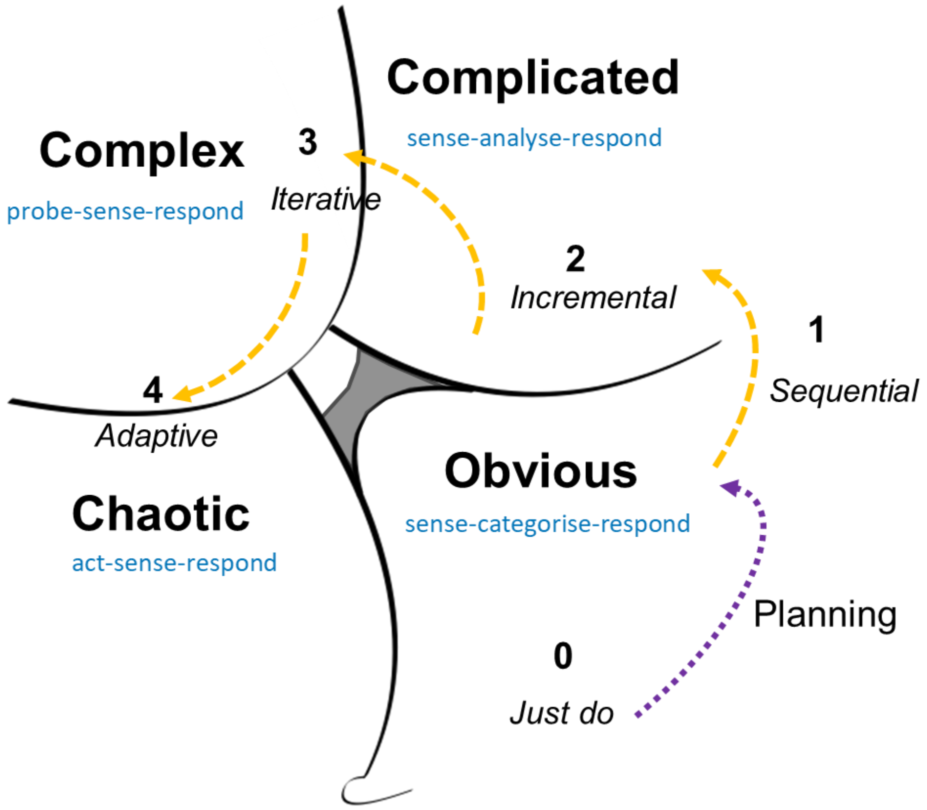


Figure 4.7: Cynefin Framework in the context of hybrid project management: combing both approaches
Source: Adapted from Snowden (2007, 2010, 2017) and Wysocki (2014), with own deliberations by integrating Wysocki's selection of project management approaches into the Cynefin framework

The combination of Wysocki's project management life-cycle models (PMLC) with the Cynefin framework could be a good indicator of when to use which kind of project management model and serves as the theoretical foundation of this research. The researcher proposes to combine the two aspects to adjust the project management approach (PMLC model) according to the situation (Cynefin framework) and that when the environment is stable (obvious or complicated) with clear objectives and high certainty in organising the change), sequential models should be preferred. When the environment is unstable (complex, at times touching chaotic) and it is not clear how change can be organised, the proposition is that iterative or even adaptive models should be preferred. If a decision is complicated, complex or even chaotic, it is hypothesised that more stable results can be achieved with agile techniques than with traditional project management approaches. In contrast to simple or uncomplicated decisions, in which the goal, solution requirement and solution path are clearly defined, complex or complicated projects entail several unknowns, but these can be determined iteratively and successively with an agile approach. It is important to design the framework conditions for a project in a way that allows room for interactions, user-defined adaptation and dynamic adaptation, which could, for example, be done iteratively. Changes can be made in varied ways in the course of a project, taking into account changed requirements or the dynamics of other influencing factors. As we have seen, agile approaches allow some variance in the target objective (scope changes). The idea is to adjust the scope but without tolerating losses in quality requirements, in the planned use of the product, increased resources (costs) or in the time planning (schedule). The focus is therefore on the delivery of quality and customer benefit as the output. As a major difference, temporary faulty development is permissible with an agile approach, but should be minimal and quickly corrected by means of short feedback cycles.

4.4 Interplay between the hybrid model, benefits and the current research gap

Chapter 2 gave insights into the theory behind the various project management paradigms. Chapter 3 focused on the latest academic discussion of Critical Success Factors. Chapter 4 focused on the development of a hybrid project management decision-making model. Section 4.4, highlights in addition the current research gap and thus justifies the present research.

Already in 2008 Dyba and Dingsoyr had concluded in their systematic literature review the benefits and limitations of agile project management and recommended a combination of agile and traditional project management approaches, depending on different organisational and project contexts.

Spundak (2014) asked in his research whether it is feasible to shape a project management practice on the basis of several approaches and suggests further research on *combining* project management frameworks and premises. On this and other data points the gaps in project management research seem obvious; there is certainly a gap in the area of hybrid project management. A systematic review by Theocharis et al. (2015) sought to collect more evidence to confirm West's finding (in Kuhrmann, 2017) that companies move towards applying hybrid project management approaches. While research on agile software development is comprehensive and multifaceted, the combining of traditional with agile approaches has been widely ignored in recent research (Kuhrmann, 2017). In the meantime, the gap is widely discussed by many practitioner and project management associations (see e.g. Grushka-Cockayne (2015) or the professional group of German universities on hybrid project management). More recently, academics have turned to the topic as well (see e.g. Jaziri et al. (2018), Lozo and Jovanovic (2012); Baird and Riggins, (2012), Spundak (2014), Conforto and Amaral. (2016), Grushka-Cockayne et al (2015), Timinger and Seel (2016), Kuhrmann et al. (2017), Imani et al (2017), Jaziri et al (2018), Papadakis and Tsironis (2018), Geraldi and Söderlund (2018), Cram and Marabelli (2018), Adelakun et al (2017), Cooper (2016), Cooper and Sommer (2018) and Wysocki (2019). However, data on ways to *combine paradigms* for hybrid project management, including the determination of the "contextual factors driving the creation of hybrid approaches" have not so far been deeply sought by academics (Kuhrmann, 2017).

Geraldi and Söderlund (2018) provide a framework for types of research on project studies. Future research in project management should not only incorporate predictions on project management processes but also consider the context and its relationships (such as the tensions and relationships between temporary and established organisations, as proposed in one project management approach), which have not occupied previous or current research on hybrid project management and therefore are considered for the envisioned research. The key differentiator between traditional project management and the project management academic movement to rethink it is the following: whereas traditional project management was seen as a set of tools and techniques used to achieve project efficiencies, RPM positions project management as a "holistic discipline used to achieve project/program/organisational efficiency, effectiveness and innovation" (Jugdev et al. 2001, p. 36).

It is hypothesised that the use of hybrid project management approaches benefits from the combined approaches that become available. Cram and Marabelli (2018), for instance, report that with a hybrid project management approach projects in which traditional project management practices were enriched with agile project management techniques were more successful than without this enrichment. Furthermore, by combining a phase-gate model with agile practices, Conforto and Amaral (2016) conclude that the application of a hybrid project management approach shows performance features, "such as information accuracy, commitment and leadership". Imani et al. (2017) find in a survey that hybrid project management approaches can actually improve project success rates, especially for large-scale projects with higher levels of requirement uncertainty. Moreover, they found that an improved cost-benefit ratio becomes more likely than with the application of purely plan-driven project management approaches. Certain other aspects, such as the integration classification of Timinger (2017), have theoretically been established but not researched yet. This aspect is thus a main research objective of this study.

With the review of the latest research in Chapter 4 it becomes evident that academic research has a major gap with regards to hybrid project management, which suggests a need for research. This is expanded on and defended in Chapter 7 by the Main Study Chapter and discussed in detail in Chapter 8. Before we move to the main study however, Chapter 6 is introducing the research methodology and the research methods, followed by a discussion on the research contribution and ethical considerations.

5. The research problem

5.1 Research Aim

The specific aim of this research is to study the use of traditional, agile and hybrid project management practices of project professionals (project managers, PMO staff, project stakeholder etc.) in Germany: The research is envisioned to identify differences between the Waterfall, agile and hybrid approaches. Using established factors from the literature, the research aims contribute to identifying when to use which project management approach. Based on its findings, a contingent project management approach will be proposed, which will give project managers guidance when to use which approach. The findings from the factor comparison will give project managers guidance and allow them and PMOs to choose a well-fitting project management set-up, based on the organisational and soft factor contexts of the project and the organisation.

5.2 Research Question

The main research question addressed in this dissertation is:

Are there any differences between traditional, agile and hybrid project management with regard to critical success factors?

<u>Research objective 1: to find</u>

1. To which degree are traditional and agile project management practices are used
2. how the two approaches are used and combined.
3. What are the existing challenges in project management with the agile and traditional project management approaches?

<u>Research objective 2: to find</u>

which challenges, in project managers' practical experience, are better addressed by traditional and which are better addressed by agile project management.

This question aims to determine if the approaches are different and to identify the challenges which are highlighted from traditional and agile project management perspectives.

These challenges are then compared to the Critical Success Factors (CSF) of project management, which are further researched under research objective 3.

Research objective 3: to find

any significant difference in Critical Success Factors (CSF) between Traditional, Agile and Hybrid project management approaches.

By using the defined CSF, this research question investigates the difference in these CSF by comparing their part in the Traditional, Agile and Hybrid project management approaches.

5.3 Testable Propositions

5.3.1 Research Propositions

$H0$: No difference exists in project critical success factors between agile, traditional & hybrid project management approaches

$H1$: Differences exist in project critical success factors between agile, traditional & hybrid project management approaches

5.3.2 Operational Propositions

Organisational factors (OF)

$H0$: No difference exists in organisational critical success factors between agile, traditional & hybrid project management approaches

$H1$: Differences exist in organisational critical success factors between agile, traditional & hybrid project management approaches

Team factors (TF)

$H0$: No difference exists in team critical success factors between agile, traditional & hybrid project management approaches

$H1$: Differences exist in team critical success factors between agile, traditional & hybrid project management approaches

Customer and stakeholder factors (C&SF)

$H0$: No difference exists in customer and stakeholder critical success factors between agile, traditional & hybrid project management approaches

$H1$: Differences exist in customer and stakeholder critical success factors between agile, traditional & hybrid project management approaches

Project uncertainty factors (PUF)

$H0$: No difference exists in project critical uncertainty success factors between traditional, agile, traditional & hybrid project management approaches

$H1$: Differences exist in project uncertainty critical success factors between agile, traditional & hybrid project management approaches

Chapter 5 introduced the research aim, the research questions and the testable propositions, which form the basis for the more specific 15 hypothesis for each Critical Success Factor (CSF) used in Chapter 8. In the upcoming Chapter 6 the Research Methodology and Methods are introduced, followed by a discussion on the research contribution and important ethical considerations for this research.

6. Research Methodology and Methods

This research design is influenced by both quantitative and qualitative approaches. A positivist perspective is used in the research methodology and a quantitative research strategy is employed. To find an appropriate research design took some time, since a more qualitative approach was envisioned at first. The reason was the perceived complexity of project management. Over time however, the researcher developed a positivistic stance as research understanding deepened with regard to the limitations of the phenomenological research stance vis-à-vis a clear applied contribution to knowledge. By defining a contingency fit model (see Chapter 3), clear Project Success Criteria (PSC) were identified for the project Critical Success Factors (CSF) that were sought.

The factual knowledge is derived from many or even few but statistically significant observations. The philosophical viewpoint of postpositivism assumes an independent, value free, generalisable contribution to knowledge by using reductionism, i.e. by focusing on some key aspects to determine a unique and independent verifiable observable truth (Easterby-Smith et al 2002). Some qualitative data were used in interviews to communicate and share findings with others and check their support or rejection of this evidence, but the main study was solely based on quantitative survey data. Research questions were frequently rephrased and tested by a careful analysis of the measures.

The literature review presented traditional and agile project management approaches to projects which with the online survey formed the basis for this investigation. Positivistic research normally starts with a hypothesis that will be verified or falsified and "one looks for evidence that will disconfirm one's hypothesis or existing view" (Easterby-Smith et al., 2002, p. 51). In this context, Popper stated that knowledge "can never be proven or fully justified … only … refuted" (Popper, 2002). Therefore, a line of reasoning can be rejected as false even if it is refuted only once. As proposed by Bryman and Bell (2015), research contributions have to satisfy the following conditions: they must be logical and free of contradictions (e.g. A>B>C, so C>A cannot be admitted); and they must be consistent with the observed facts that in the present research result from surveys and interview feedback. The hypothesis was formulated to meet both conditions based on the discussion in the literature.

The present research was split in two phases. An online survey which yielded quantitative data was first carried out in phase 1. The detailed design and administration of the primary data collection were determined in a pilot online survey via mainly direct interaction among the members of the Project Management Institute, Germany Chapters. In the second phase, the findings were analysed to determine the differences of CSF between the traditional, agile and hybrid project management frameworks. The researcher also used his working environment in addition to the member base of the Germany Chapters of the Project Management Institute, to gain more detailed, practical insights, and used these also to triangulate the research results. Appendix 3 presents an example of the study's focus group, which discussed the issue in project management represented by the factors used in this study from a practical perspective to ensure this academic research was aligned to the concerns of project practitioners.

6.1 Methodology

This research is aiming to identify and assess the differences in critical success factors that explain the effectiveness of various project management approaches, takes a positivistic stance. The problem of identifying contingencies requires further understanding, especially given the fact that neither traditional nor agile project management approaches are used any longer in their pure form, as shown by the Helena study (Helena, 2017) and by this research. Currently many organisations and project manager experiment with hybrid approaches as they encounter issues with traditional and agile project management approaches in organising projects. The objective is therefore to enquire if there is a difference between traditional, agile and hybrid project management per se in dealing with certain project management problems and to gain insights into hybrid project management.

Since only a small number of projects have been carried out in a setting labelled hybrid project management while many have combined various project management approaches, it was hypothesized that many project managers do indeed mix approaches and practices. Hence it is believed that a study will yield more insights into a practice that so far has not been deeply researched.

As previously noted, the pillar of this research was to analyse an online survey questionnaire yielding mainly quantitative data. The data used in this research were based on the statistical analysis of the association between 15 identified project problems and project management issue variables. In this statistical analysis, t-tests were used to determine the significance of the factors and Mann-Whitney-U tests were used to identify differences between the project management approaches under scrutiny. A more detailed review and justification can be found in Chapter 8.

Before looking into the details of methodological justification, some definitions are presented once more as a recap. A postpositivist research methodology is believed to be the most suitable research strategy for addressing the present research questions because it is an appropriate way of finding in a repeatable, statistical manner how project management issues are identified. Research tested with postpositivistic approaches gain a better understanding of quantifiable phenomena (Bryman and Bell, 2015). Like positivistic, postpositivistic research assumes that there is a "objective reality" in any research question, which should be irrespective of the researchers who are investigating or the methods used (Bryman and Bell, 2015). Hence also postpositivist research use a highly controlled and structured research approach. The idea is to reduce the number of variables in the hypotheses and research questions. For this purpose, formal assumptions were made in this research, quantifiable characteristics of variables were used, hypotheses tested or drew inductive inferences about a phenomenon (Creswell, 2009). Postpositivist research normally makes use of theory to test findings in order to improve the understanding of phenomena (Myers, 1997). However, while positivists emphasize independence between the researcher and the person (or object) being studied, postpositivists argue that hypotheses and theories, background knowledge and values of the researcher *can* influence what is observed, meaning knowledge is conjectural and absolute truth can never been found (Phillips and Burbules, 2000). This means that research has always some degree of impfection and is potentially fallible (Phillips and Burbules, 2000). Hence, postpositivists pursue objectivity by recognizing the potential impact of biases (Phillips and Burbules, 2000).

Interpretivism in contrast approaches research to comprehend and explain the world differently by assuming a human and socially constructed reality (Bryman and Bell, 2015). Interpretivism assumes an ontology in which socially constructed reality assumes processes by which social actors together negotiate the meaning of actions and situations (Crotty, 1998). Positivists, however presume that objective knowledge can be found by means of generalisation and abstraction (Creswell, 2009).

Interpretivists believe that reality can be comprehended only from an epistemological position that requires social science to grasp the subjective meaning of social action and hence avoid the inflexibilities of postpositivism towards certain types of problem in the social field (Bryman and Bell, 2015). They try to explain causal relationships through "hard, factual data" but in fact rely on a more subjective process for their understanding of reality, allowing different participants' perspectives to reveal the multiple realities of the world in a given context (Crotty, 1998). With this in mind, the following section asks why the decision was been made to take a postpositivistic stance in the present study.

6.2 Justification of methodology, questionnaire design and sampling approach

Quantitative approaches alone do not necessarily answer this question, especially in small-scale research, which therefore suggests further enquiry. General project management variables and input parameters have been identified in any contribution that has been completed (see Chapter 3).

However, since the hybrid project management approach has not hitherto been intensively researched, the idea was developed to use existing research on traditional and agile project management and enlarge the knowledge base by investigating the observable practice of combining traditional and agile project management practices. With this a new insight and perspective increased the knowledge of this rather recent development. Since only one limited study (see Kuhrmann, 2017) has examined the *integration* of some other project management methodologies which relate to the hybrid project management model, this insight was expected to advance the insights from recent practices. Quantitative data (from the survey) were used in the research. Hence, the method focused on and analysed quantitative data in terms of statistical frequencies. Triangulation, which uses more source of data (Bryman and Bell 2015) was achieved by balancing diverse participants from one organisation (the insurance group Allianz[7]) with others from several other organisations (via the PMI Chapters) to ensure that the insights were representative and broad in nature. Collecting the main data from an online survey and analysing them ensured the postpositivistic stance of the study.

To summarise, the tangible deliverables of this research were insights into hybrid project management **from an objectivist stance, based on a postpositivist epistemological position supported by the method of an online survey**. This added up to a survey method with a postpositivist approach (Creswell 2009, p. 6) which as a research methodology was considered a suitable way of addressing the research questions highlighted above. An overview is given in Table 6.1 and Figure 6.1:

Table 6.1: Overview of methodology

Comparison Dimension	Dimension/ characteristic for this research	Justification
Ontological assumptions/Nature of reality?	Reality is objective and singular, e.g. “what are the project issues or problems?” can be measured with objective criteria.	The research follows the ontological assumption with objective and a single reality. A circular approach of phenomenal research based on a postpositivist worldview and stance (see Creswell 2009, p. 6) was used.
Epistemological assumptions	Researcher interaction was limited by what was researched	It was anticipated that information could be retrieved with no interaction (online survey) or only a minimum. The notion was that “the researcher brackets or sets aside his or her own experiences in order to understand those of the participants in the study” (Niewswiadomy 1993 found in Creswell 2009).
Type of research	Survey Research	Quantitative details were obtained by an online survey. A postpositivist worldview (Creswell 2009, p. 6) was used.
Methodological assumptions	Deductive process	Deductive reasoning determined the relationship between theory and research in which the latter concluded with reference to hypotheses and ideas were inferred to gain understanding of the use of practical hybrid project management in practice (Bryman and Bell 2015).

Figure 6.1 summarises the method and approach:

[7] Allianz Group was chosen as source of potential particiapants as the researcher is employed by this company group. This allowed the researcher to gain access to Allianz’s project management community, a group within Allianz of mainly PMI certified project managers. This group of project management professionals are mainly PMI members and fit to the overall population.

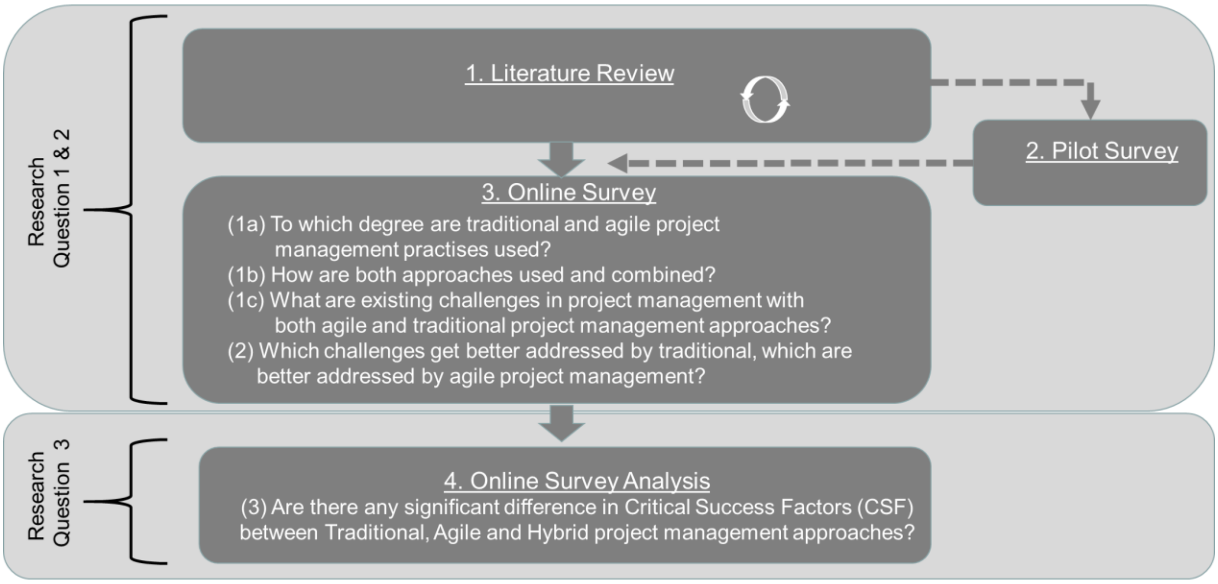


Figure 6.1: Methods used Source: own representation

Initially, and as an input for the intermediate submission of this research, a **pilot survey** was undertaken to check the wording of the instructions and the effectiveness of the survey in fulfilling the purpose of the study. This research was organised in two phases, each of them referring to one of the research questions (see Figure 6.1). In the first phase, an overview was created by reviewing the literature on hybrid project management, as previously outlined, and primary data was collected in an online survey. The idea was to gain insights into the status of this recent development and query what had been experienced in combining these project management practices. The combination patterns were tested during the pilot, as well to confirm the existence of hybrid project management. In this example the classification of traditional vs. agile project management and their characteristics was used (see Chapter 2). The same approach was used to frame Research Question 2 about which challenges get better addressed by traditional and which are better addressed by agile project management. Research Question 3 was to be answered via the online survey results gathered from project management professionals the Project Management Institute Germany Chapters (PMI Germany) and from Allianz Group. A summary of the research method used can be found in Table 6.2.

During the pilot also the type of questions and the flow was tested. The researcher has received some feedback from the 1:1 pilot survey interviews that some of the questions where not clear and somewhat confusing. This was addressed by examples and additional explanations and an adjustments of the survey flow were introduced and retested in the online questionnaire (see Appendix 1 and 2). Also, during the pilot, the graphical representation of the questionnaire had been adjusted to become more user friendly. For instance, a matrix table was introduced (instead of individual selections) to fill out the questionnaire more efficiently has been implemented for the final survey.

In the following section an overview of the survey is given. In line with the research questions 1-3, the survey had 3 sections:

Table 6.2: Justification of survey questions and design

Research Question (RQ)	**Survey Question(s)**	**Justification**
<u>Research Question 1</u>		
1. To which degree are traditional and agile project management practices are used?	• Which project management approaches do you use?	• To gain an understanding if the right project management models were identified (from literature review) and no important model was missing.
	• How would you rate your project management approach?	• To gain understanding of importance of approach relatively to each other.
2. How the two approaches are used and combined?	• Do you combine project management frameworks, methods, tools or process models? • Which project management frameworks, methods, tools or process models do you combine? • How do you combine or adjust project management approaches?	• To prove that hybrid project management does exits and is a widespread phenomenon • To prove that combinations actually take place • To gain and understanding how combination patterns evolve • To gain insights to the combination patterns

<u>Research Question 2</u> Which challenges, in project managers' practical experience, are better addressed by traditional and which are better addressed by agile project management?	• Of the main project management challenges, you have encountered, which one do you believe are better addressed • ...by Agile Project Management (APM)? • ...by Traditional Project Management (TPM)?	• To identify which challenges (represented by CSF) get better addressed by which project management approach better
<u>Research Question 3</u> Are there any significant difference in Critical Success Factors (CSF) between Traditional, Agile and Hybrid project management approaches.	• What are your main project management challenges you have encountered?	• To identify differences in project management approaches (represented by CSF) for the analysis of differences in project management approaches

More details on the survey design and flow can be found in Appendix 1 and 2.

6.3 Method and approach: how the online survey data was analysed, justification of sample size

The following table lists the methods for this research and gives more detail on the method of analysing the data

Table 6.3: Research method used

Comparison Dimension	Dimension/ characteristic for this research, sampling	Justification	How was data analysed?
Types of question	Hypothesis testing	Do existing important constructs and variables also apply to hybrid project management or is there a fundamental difference with this recent phenomenon?	The gathered data was analysed to create the following input for the development of questions leading to constructs for understanding. The assumption was that these hybrid project management approaches use traditional and agile scrum project management methods and tools which can be incorporated to create an integrated model. For the *significance* of each CSF, a t-test has been applied. For the test of differences *between* the project management approaches a Mann-Whitney U Test has been applied due to the lower numbers after stratification. See Chapter 8, '2-tier approach of factor significance and differences in project management approaches' for more information and justification on the use of the statistical test. Further details on the statistics can also be found in Appendix 4.
Method	Data from the participants in the survey from the PMI Southern Chapter and project managers from Allianz Group.	Access to data was achieved by a) Access to PMI Germany network b) PMI members of the researcher's company	
What is the sample, who will be sampled? – how are participants chosen? What is the sample size? How was the survey administrated?	Project Management Association with more than 3,300 members (Nov 2019) **Sample size: >300 participants** Allianz Project Management Community ca. 50-60 members **Sample size:** **20-40 participants** The survey `was administered with the Qualtrics online survey tool **https://hwsml.eu.qualtrics.com/** Questions were similar to the Helena study's (Helena, 2017)	Project Management Association consists of project manager professionals in various industries (among others, Automobile, Finance, Administration, Engineering). The survey was to be placed on the association's web-site and announced during Chapter meetings PMI Project Management professionals within Allianz of different experience levels and function (project manager, PMO, management), Internal company project manager community. The survey was promoted during community calls.	For this the literature review findings were used and contrasted with the data found during the online survey of the project management professionals: In the survey, PMI Project Management Institute participants and PMI Project Management professionals within Allianz were invited to describe the status of traditional and agile uses in the online survey and to identify any hybrid project management experience. PMI is the leading project management association with more than 3,300 members in Germany. Almost all of the members are PMI certified; hence it can be guaranteed that this population has sufficient knowledge and experience to take part in the survey. Similar deliberations hold true for the Allianz Project Management Community, which by definition are project managers within Allianz Group, many of them are PMI members. With regard to sample size, a population of 3300 with confidence level of 95% and a confidence interval of 5% require a sample size of 344. Hence a clear number of > 300 was targeted for this research.

6.4 Research Contribution and Contribution to Theory

In the research, the project management framework to be developed was designed to help organisations to advance their project management functions, which consequently would support organisations by improving their chance of successfully managing projects in an increasingly dynamic environment. This would improve managers' power to choose traditional, agile or hybrid project management approaches in their own project environment (see the classification in section 3.4 of the Cynefin Framework), relevant for both project management practitioners and academia.

For practitioners it was relevant because in current project management practice traditional and agile project management approaches are still by and large used in isolation and supporters of each camp seem to wage irreconcilable ideological disputes. For academia it was important to acknowledge and incorporate the increased need for flexibility for the sake of change in project management models but at the same time to incorporate planning security in good management practice and the related project management theory. The link of the study, the theoretical framework and the output can be seen in Figure 6.2:

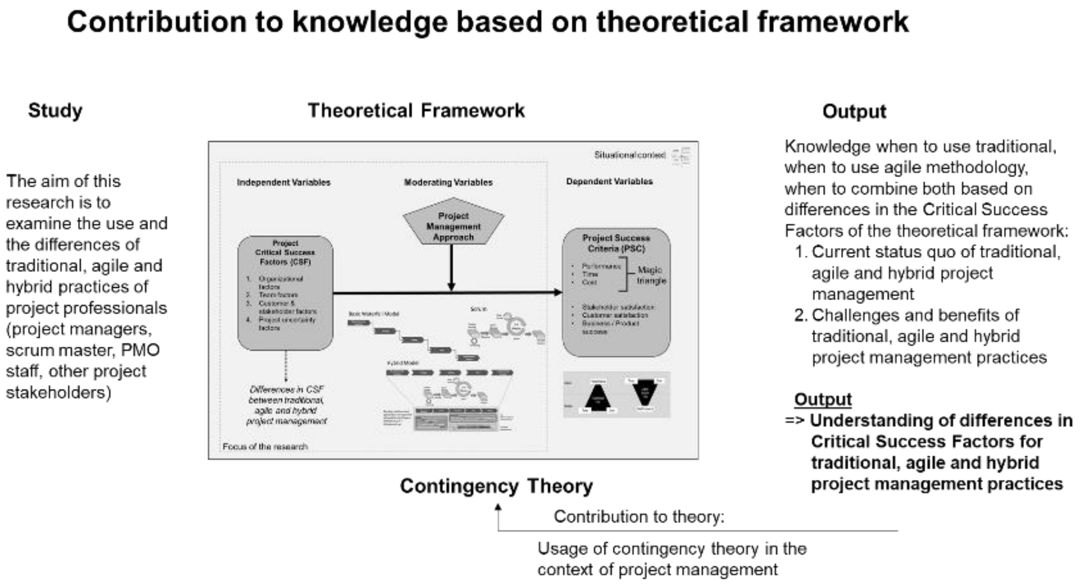


Figure 6.2: Contribution to knowledge based on theoretical framework
Source: own representation

Using the 15 Critical Success Factor (CSF) in this research will give us insights when to use which project management approach. Based on the previous literature, the following context factors were found:

Table 6.4: Situational criteria / context factors for the use of traditional and agile project management as found in the literature

Situational criteria (context factor)	**CSF**	**When to use which Project Management approach**		
		Traditional	*Agile*	*Hybrid*
Planning reliability vs. required agility	Planning and deadline (PD) Clarity in describing on how to organise change (OC) Clarity in expectation management and delivery (EM) Communication (CO) Resource conflicts or deprivation (RC) Prioritizing of task and activities (PT)	Top level management requires adherence to plans and to fixed and agreed project deliverables (Ahimbisibwe et. al., 2016, Wysocki, 2019, Timinger, 2017, Dvir and Lechler (2004).)	Top level management supports adaptive behaviour and requires adjustments of an optimal project delivery (Sheffield and Lemetayer, 2013, Ahimbisibwe et. al., 2016, Timinger, 2017, Slevin and Pinto (1988), Frey et al. (2009)	**CSF not researched yet for hybrid projects** *Main focus of this research and research gap.*
Specification, Customer centricity or involvement	Goals or requirements (GR) Stakeholder support and engagement (SS) Solution fit (OS)	Minimally involve users, customers or stakeholders throughout the project life-cycle (Misra et al, 2009, Sheffield and Lemetayer, 2013)	Integrated involvement of users, customer or stakeholder throughout the project life-cycle, specific representation if customers are highly trained or experienced and willing to participate in project work (Chow and Chao 2008, Misra et al, 2009, Ahimbisibwe et. al., 2016) Ika et al. (2012), Serra and Kunc (2014) and Taherdoost and Keshavarzsaleh (2016)	

Interdependency and Complexity situation	Understanding of complexity and interdependencies (CI) Risk Management (RM) Scope changes (SC)	When situations are easily predictable (Ahimbisibwe et. al., 2016) “Obvious” and mainly “Complicated” situations (Snowden, 2019, Snowden, 2017 a/b, West et al., 2011, Kerzner 2014, Wysocki 2019)	In conditions of uncertainty (Vinekar et al, 2006) Mainly “Complex” situations with short episodes of “Chaos” (Snowden, 2019, Snowden, 2017 a/b, West et al., 2011, Kerzner 2014, Wysocki 2019)	
Corporate culture and team mentality	Accountability (AC), Team dynamics / team building (TD), Team skills (TS)	Suitable if project team is characterized and comfortable with less flexible leadership styles (Autocratic Leadership, Bureaucratic Leadership, Transactional Leadership) (Goleman, 2000, McManus, 2007, Moe et al. 2010, Rothman and Kilby, 2019, Hoegl and Gemünden,(2001) Mir and Pinnington (2013), Jun et. al (2011) and Xu et al (2010))	Suitable if project team is characterized and comfortable with flexible leadership styles (Democratic Leadership, Laissez-Faire, Leadership, Transformational Leadership, Coach-Style Leadership) (Goleman, 2000, McManus, 2007, Moe et al. 2010, Rothman and Kilby, 2019, Hoegl and Gemünden, 2001, Mir and Pinnington (2013), Jun et. al (2011) and Xu et al (2010))	
Summary		Top level management requires adherence to plans and to fixed and agreed project deliverables (Ahimbisibwe et. al., 2016, Wysocki, 2019, Timinger, 2017, Dvir and Lechler (2004).)	Top level management supports adaptive behaviour and requires adjustments of an optimal project delivery (Sheffield and Lemetayer, 2013, Ahimbisibwe et. al., 2016, Timinger, 2017, Slevin and Pinto (1988), Frey et al. (2009)	[To be researched – see Chapter 8]

6.5 Ethical considerations

Ethical issues are also important in research, because the principle of informed consent or mindful inquiry needs to be reflected in the research (Coghlan and Brannick, 2001). According to Coghlan and Brannick (2001), the following ethical issues which are of importance in academic practise were considered and resolved by the researcher.

The researcher:

1. Ensured the privacy of identity, data and confidentiality of the respondents' information
2. Guaranteed participants have the right to decline to participate in the research (voluntary participation)
3. Obtained permission to use documents used for other possible purposes
4. Kept good faith and always checking to minimize the risk of misunderstanding
5. Negotiated with those concerned how information and data are used and published
6. Disclosed participants' data privacy rights and study purpose
7. Applied standards of the Heriot-Watt University's and Business School's ethics committee

The researcher is fully aware that the above principles are crucial for any research and therefore agreed to adhere to them during his studies.

The next Chapter 7 will introduce the core research with the main study.

7. Main Study

7.1 Introduction to Questionnaire Results

In the following section, results of the data collection are presented. The survey was available from November 2019 to June 2020, after the completion of the pilot in September 2019. Multiple invitations to staff to take part in the survey were extended by means of the researcher's professional network and by posting requests to project management communities such as the PMI Germany Chapters (PMI Southern Germany, Berlin, Frankfurt and Cologne – see examples in the Appendix). In addition, the survey was promoted in PMI Chapter Meetings and events. This resulted in the completion of 382 responses. Of these 312 were of sufficient quality and the data are presented in the following graphs. The following data analysis is graphically represented in them. Note, however that due to the use of different workflows in the questionnaire, some graphical representations have fewer participants in some questions. For example, Question 4 asks 'Do you combine project management frameworks, methods, tools or process models?' This elicits whether or not the survey participants combine project management approaches. If they do not (which represents c. 20% of all survey participants), they are asked why they do not use a combined approach. Due to the workflow of the survey, these participants did not state how or why they combined project management approaches before being directed to another section of the questionnaire. Moreover, not all the sub-answers or selection items were answered by all participants, which also led to differences in the data available.
With regard to the internal consistency of the data, a Cronbach alpha analysis was completed. The overall result for the factors on project management issues measured by the critical success factors for the hypotheses resulted in a Cronbach's alpha of 0,81, which is a good, acceptable value (Bryman and Bell, 2015). More details of the analysis can be found in Appendix 7.

The next section is structured as follows: it first reviews the demographics of the survey participants to give better insight, background and understanding of the data obtained. This is followed by a detailed review of the survey questions using descriptive statistics to gain answers and insights to research questions 1 and 2: "How far are traditional and agile project management practices used? How are the two approaches used and combined? What are the existing challenges in project management with both agile and traditional project management approaches?" and "Which challenges are better addressed by traditional, which are better addressed by agile project management?"

For research objective 3: "Is there any significant difference in Critical Success Factors (CSF) between Traditional, Agile and Hybrid project management approaches?", more sophisticated statistics (descriptive and inferential) were used. Inferential analysis makes it possible to test against previously introduced testable hypotheses by means of group comparisons. For the analysis, 3 groups out of the data clusters were defined, consisting of 1. Traditionalist, 2. Balanced/Hybrid and 3. Agilist answer groups (see "Question 3 How would you "rate" your project management approach in your organisation: Which approach do you mainly use?").

The sub-groups from the questionnaire were mapped to combine groups for analysis by aggregating the traditional and agile project management sub-group to a single group for this purpose. By establishing these group clusters, differences could be analysed by means of hypothesis testing. The following represents the defined analysis groups derived from the original question 3 category:

Table 7.1: The original selection from the survey is shown on the left and the mapping to a group for analysis is shown on the right

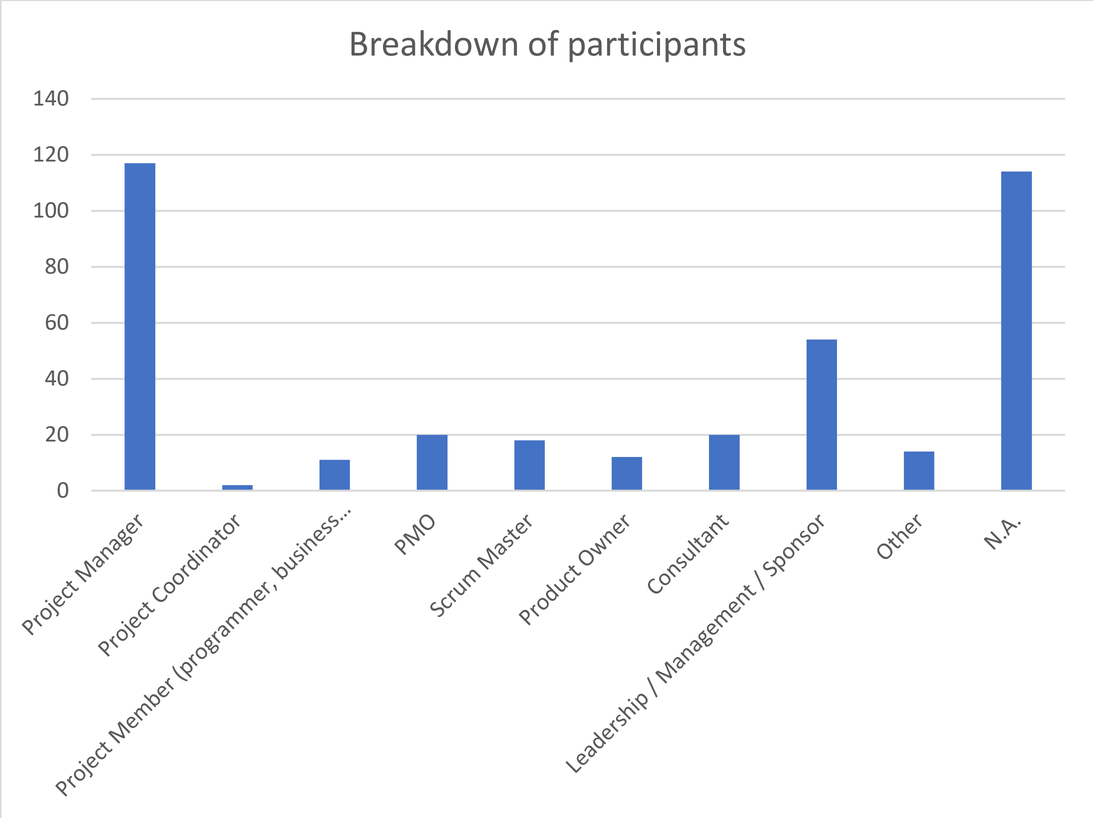
Sub-Group from Question 3	**Group for Analysis**
Fully Traditional	**Traditional Group**
Mainly Traditional	
Balanced between Traditional and Agile	**Hybrid Group**
Mainly Agile	**Agilist Group**
Fully Agile	

For this research question, the previously identified project management factors from literature were highlighted and reviewed.

7.2 Demography

The survey was active from November 2019 to June 2020. The latest data were taken on June 9th, 2020. As previously noted, during this time many promotions encouraged project management professionals to take part in the survey, including advertisement in the PMI Chapter, presentations on behalf of PMI, an article on LinkedIn and direct contact via the LinkedIn network (see Appendix 3).

As most of the invitations were targeted at project managers with PMI credentials, it is not surprising that most of the respondents described themselves as project managers. The second largest group was from management, which was helpful, since managers and stakeholders play an important part in the success of projects (see also section 3.2.3). A good number of participants chose not to disclose their role: 57 chose not to input complete survey information, 60 preferred not to disclose their role but completed the survey otherwise. Additional roles consisted of those which were close to project management activities, such as consultants, PMOs, Agile roles (see Section 3.3.1) such as Scrum Master and Product Owner, project members and project coordinators. A small number classified themselves as 'Other'.



Breakdown of Participants		**%**
Project Manager	117	31%
Project Coordinator	2	1%
Project Member (programmer, business analyst, IT architect)	11	3%
PMO	20	5%
Scrum Master	18	5%
Product Owner	12	3%
Consultant	20	5%
Leadership/Management/Sponsor	54	14%
Other	14	4%
N.A.	114	30%
Total	**382**	100%

Figure 7.1: Roles of survey participants

Note: of the 114 participants who did not disclose their role, 57 participants merely skimmed the questions and had to be excluded.

7.3 Research questions 1[8]

The first research questions looked into the status quo of project management approaches and the high-level combination patterns. It also researched the existing challenges in project management. The following are the sub-questions of research question 1:

1. To what degree are traditional and agile project management practices used?
2. How are the two approaches used and combined?
3. What are the existing challenges in project management with the agile and traditional project management approaches?

Question 1 Data privacy acceptance

(not a relevant research question, hence excluded here)

Question 2 Which project management approaches do you use[9]?

This question looked into project management through the analysis of the project management approaches used in practice. By analysing the project management approaches used (see also Chapter 2), these approaches formed and bound together the basis for hybrid project management approaches from the various project management practices. This research question was motivated by a finding from previous studies (Helena, 2017) that hybrid project approaches are clustered and formed around centres. As an initial step, the objective was to identify such centres, which are consequently used in combination patterns forming hybrid project management. Hence as a starting point of this research question, an overview to original, uncombined usage of the project management approaches is provided in Figure 7.2.

[8] Represented by questions 2 to 7 in the survey; see Appendix 1.3

[9] Although Design Thinking and DevOps are strictly speaking no project management approaches, these have been added to the questionnaire as research shows (e.g. Helena, 2017) that both approaches are common combination patterns enriching established project management approaches

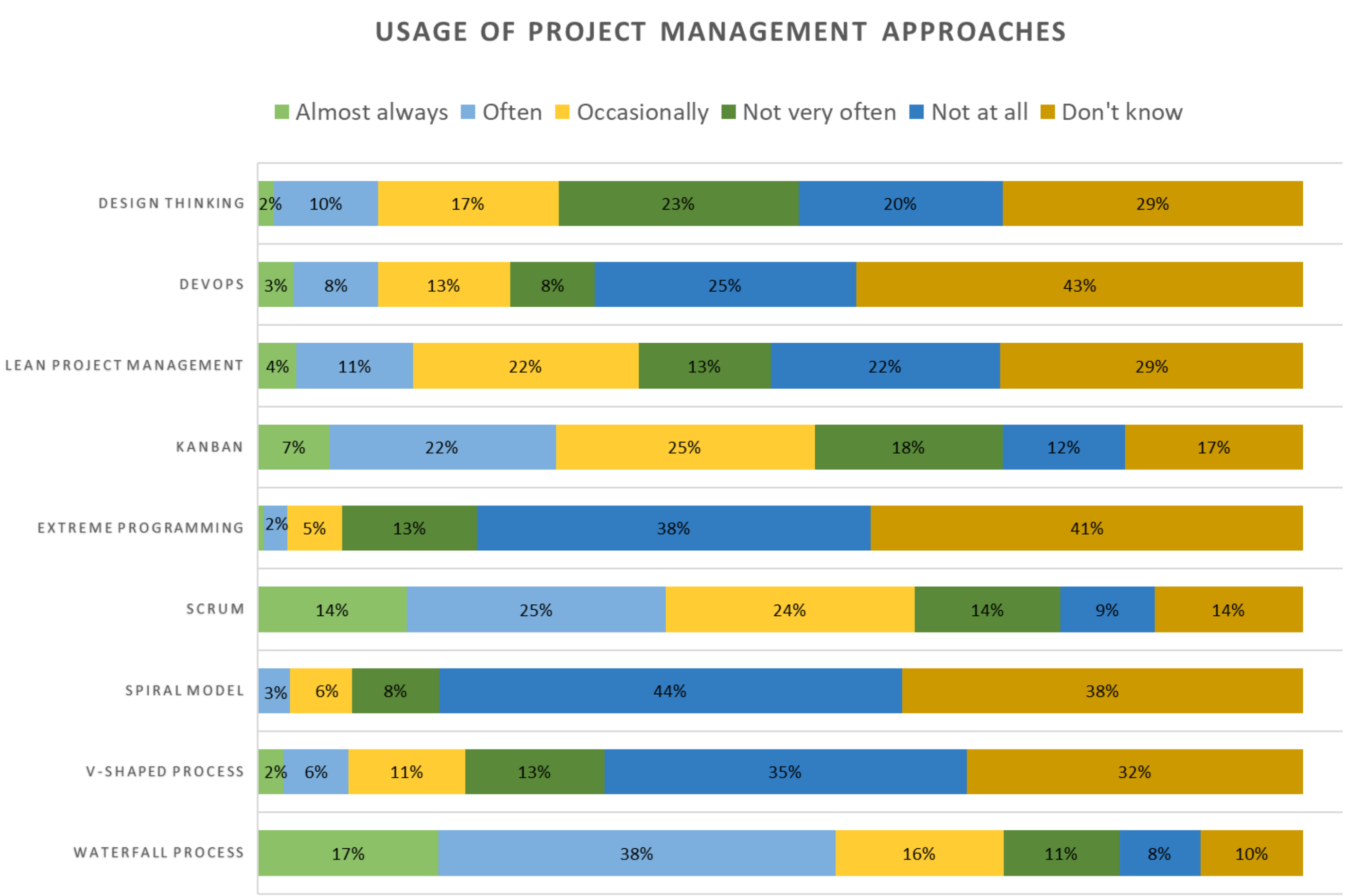


Figure 7.2 Question 2: Usage of Project Management approaches in the study

As can be seen from Figure 7.2, the most prevalent project management approach is still the traditional Waterfall process. Other traditional project approaches such as the V-shaped model and the Spiral model are used only in specific and limited situations, when the validation of the deliverable is in focus. Hence, the V-shaped model is only used often or occasionally by 33% of the sample. In most cases (35% and 44%) it is not used at all and a high proportion of professionals (32% and 38% respectively) did not know that these specific traditional project management approaches existed.

However, agile project management is clearly on the rise, with Scrum being the second most prevalent project management approach. Scrum has the greatest general importance of all agile approaches. 77 % of the participants replied that they used the approach often or occasionally 39% (=14%+25%) and 38% (=24%+14%), while only about 9 % consider it not relevant for their area, unimportant or of minor importance.

Kanban is the agile approach with the second highest rating from 71% (28%+43%) of the survey participants. 29% (7% +22%) use Kanban project management often and 43% (25%+18%) use Kanban on a regular basis. Lean project management, which applies Lean principles is quite prevalent and used by ~50% of project managers (4%+11%+22%+13%), but the survey reveals that this practice seems to be used rather selectively (a larger portion of 34% record occasional use). Interestingly, only a small number of survey participants did not use it at all or did not know it (17%). Extreme Programming is a method that focuses on programming tasks and hence plays a major part in software development. This approach defines a process model for software projects with a focus on risk management and the fulfilment of the customer's requirements in small steps. Probably similar to DevOps, its use is primarily in software project environments but is used quite selectively. Only 32% of the survey participants (3%+8%+13%+8%) used this approach, the vast majority either declared they did not use it (20%) or did not know it (43%).

The more newly surveyed approaches (although strictly speaking not always project management approaches), such as Design Thinking and DevOps, were added to the survey because they play an important part in many change management activities. Interestingly, Design Thinking for most survey participants was quite important, with 52% (2%+10%+17%+23%) responding that they used this practice either often or occasionally. Only 20% responded that they never used this practice and 29% that they did not know the Design Thinking approach.

In contrast, only a modest number of survey participants used DevOps 32%, but quite a number (25%) knew it but did not use it. But a significant percentage did not know this approach (43%). This is probably because DevOps is mainly applied only within software or service products.

For hybrid project managers, the approaches depicted in Figure 7.2 are of great importance since they form the basis for mixed project management approaches. For the selective use of hybrid approaches, agile approaches such as “Scrum”, “Kanban” and “Lean” are also of importance in constituting their hybrid approach. In contrast to the consistently either agile and traditional project managers, the free text comments in the collected data for “Design Thinking” suggested its importance for both traditional and agile project management users. It gives many product development projects greater ability to 'bring up' innovations and new ways of working for new products and business models.

Question 3 How would you "rate" your project management approach in your organisation: Which approach do you mainly use?

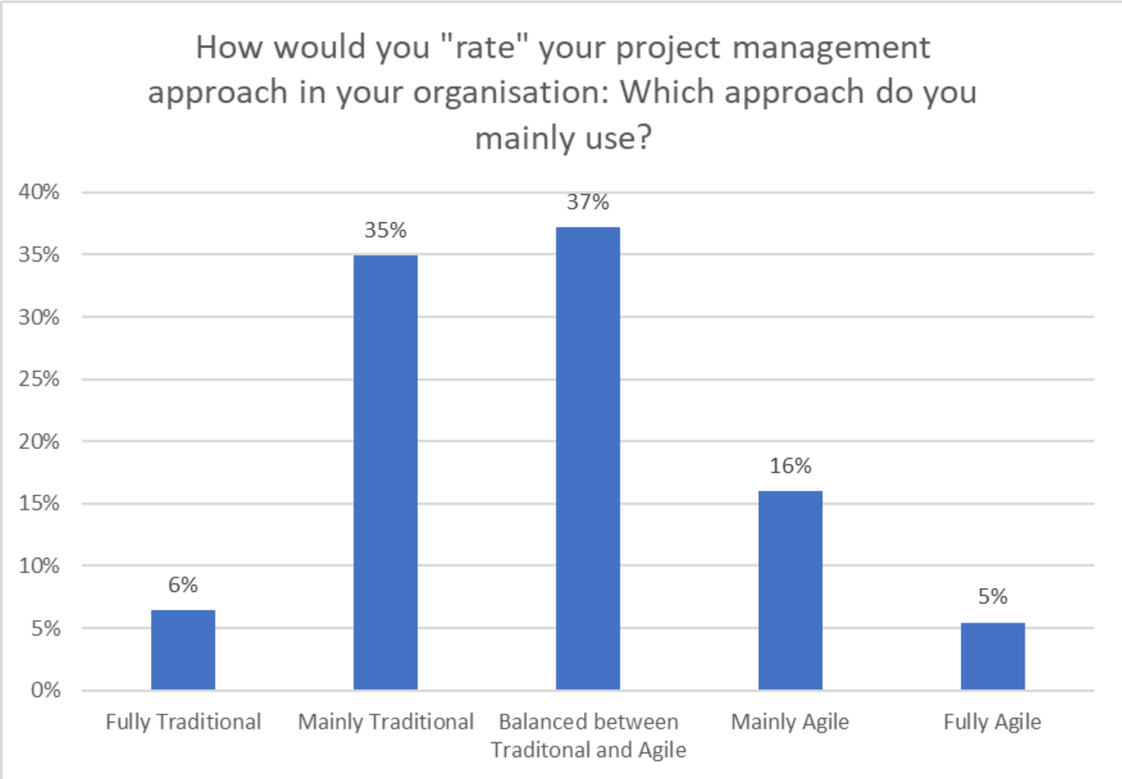


Figure 7.3 Question 3: How would you "rate" the project management approach in your organisation? Which approach do you mainly use? N=312

Figure 7.3 shows the frequency of project management practice relative to the use of either traditional or agile project management and the use of both agile and traditional approaches in each organisation. Most (116 of 312, or 37%) project managers combine agile and traditional development approaches; but 109 project managers (35%) mainly used traditional project management approaches and 20 project managers, representing 6% of the respondents, reported that they used only traditional approaches in their organisation. Conversely the number of project managers who used mainly agile approaches was 50, which represents 16% of the survey participants. Surprisingly, given that agile project management approaches have been a major trend in the last 10 years, only 5% or 17 survey participants reported that their organisation would never use any traditional methods.

In the German Status Quo (Scaled) Agile 2020 study results, Komus (2020) identified a decreasing proportion of participants who do not use agile approaches at all. For example, the share of those who worked in a classical way throughout has fallen from 22 % in 2012 to 8 % in 2019, which also indicates that agile approaches have been widely accepted in practice. The study of Komus (2020) revealed the proportion of hybrid users to be significantly higher than in previous studies. The proportion of hybrid users increased from 27% in 2012 to 43% in 2019, which is a low finding for this research but shows a similar acceptance of hybrid project management. The proportion of consistently agile users has remained relatively constant over the years and confirms that the introduction and use of agile seems to have found its maximum level (Komus 2020).

Question 4: Do you combine project management frameworks, methods, tools or process models?

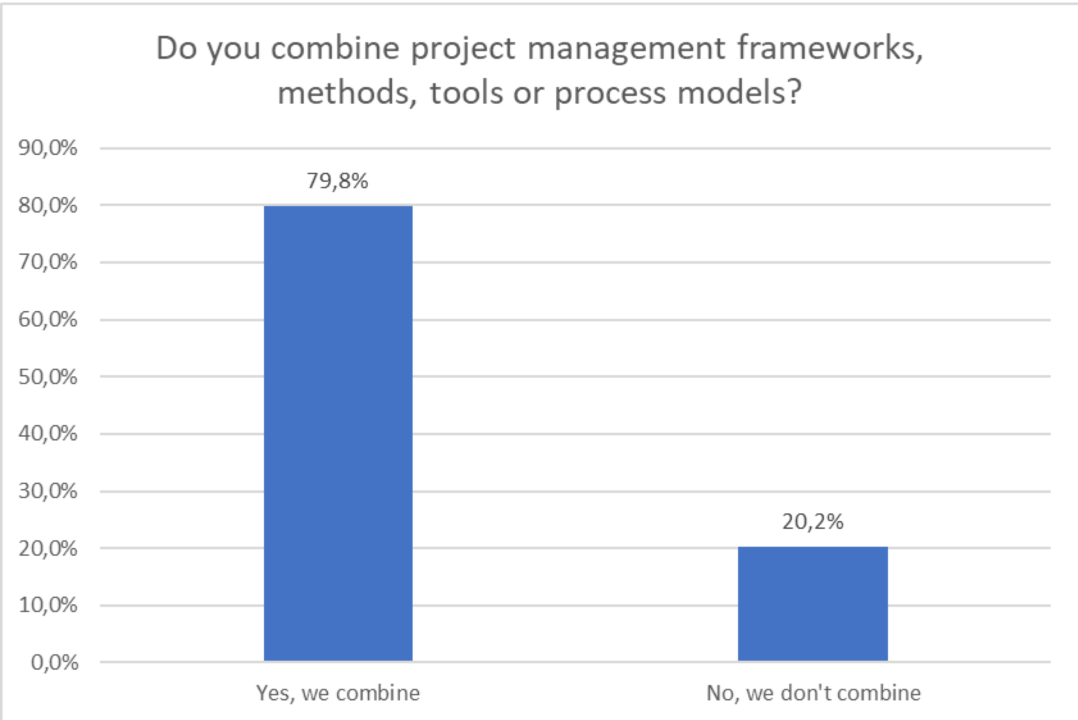


Figure 7.4 Question 4: Do you combine project management frameworks, methods, tools or process models? N=312

The intention in research question 4 is to capture the state of practice in the use of combined project management approaches. As shown in Figure 7.4, almost 80% of all the survey project participants combined different project management frameworks, tools or process models. Of the 312 participants, 249 (79.8%) stated that they combined different development approaches for a hybrid project management approach. This finding is similar to the finding in the Helena study: that 76.8% of all project managers combined different project management approaches and tools (Helena, 2017). With the chosen development approach, most companies strive towards improved productivity and cost (71%). This means that only a minority using their chosen project management model in its pure form and most apply changes to existing models creating a hybrid use of multiple project management frameworks and tools.

This development has a significant impact on the practice of project management: In the past, project management associations such as IPMA, Prince2 or PMI defined and derived project management standards in an exclusive framework. Other practices or standards were seen as competing frameworks and hence their approaches were not integrated in the existing project management standards and frameworks. The introduction of PMI's disciplined agile approach changed this, for the new approach in project management does not require a PMI certified project manager to rely only on PMI tools and frameworks but rather uses best, good and emergent practice in the framework (see also the Cynefin Framework in section 3.4.1 Figure 3.4) and allows the project management approach to be adjusted to the context (PMI, 2020). The objective of this is to enable project managers to reach a best fit to the situation as described by the model used for this research (see the Contingency fit model Figure 3.2: the "situational factor" of the model) and is represented by Table 6.4: Situational criteria / context factors for the use of traditional and agile project management as found in the literature.

Linking academia with practise, it is worth noting the latest developments at the Project management Institute (PMI). PMI states (PMI, 2020) that "the PMI Disciplined Agile (DA) tool kit is a *hybrid* that builds upon the solid foundation of other methods and software process frameworks. DA adopts practices and strategies from existing sources and provides advice for when and how to apply them together. In one sense sources such as Scrum, Kanban, PMBOK Guide, and more provide the process bricks and DA the mortar to fit the bricks together effectively".

Although the researcher believes that the statement was certainly aimed at customers and hence has a marketing tone, the direction of the PMI's strategy can be derived: it appears to be that project management associations, partly due to the success of agile project management initiatives by industry and commercial organisations have now abandoned the idea of providing a single static project management framework but acknowledge that different aspects, frameworks and tools make sense in different situations. This thinking lays the foundation of a context-driven, hybrid project management approach, and provides evidence of the departure of the monolithic thinking of singular “best practice” standards set by project management associations in project management (“one standard fits all”).

Question 5: Which project management frameworks, methods, tools or process models do you combine?

Table 7.2: Question 5: Which project management frameworks, methods, tools or process models do you combine?

Project Management approach combined with =>	**Classic Waterfall Process**	**V-shaped Process**	**Spiral Model**	**Scrum**	**Extreme Programming**	**Kanban**	**Lean PM**	**DevOps**	**Design Thinking**
Traditional Waterfall Model	X								
V-shaped Process	20	X							
Spiral Model	6	1	X						
Scrum	128	18	8	X					
Extreme Programming	2	1	0	12	X	4			
Kanban	98	10	6	71	2	X	11		
Lean Project Management	42	3	3	23	2	13	X	2	
DevOps	20	1	3	32	3	15	5	X	3
DesignThinking	49	5	3	35	3	14	9	2	X

Project Management approach combined with =>	**Classic Waterfall Process**	**V-shaped Process**	**Spiral Model**	**Scrum**	**Extreme Programming**	**Kanban**	**Lean PM**	**DevOps**	**Design Thinking**
Traditional Waterfall Model									
V-shaped Process	2,9%	X							
Spiral Model	0,9%	0,1%	X						
Scrum	**18.6%**	2,6%	1.2%	X					
Extreme Programming	0,3%	0,1%	0,0%	1.7%	X	0,6%			
Kanban	**15.2%**	1.5%	0,9%	**10,3%**	0,3%	X	1.6%		
Lean Project Management	6.1%	0,4%	0,4%	3.3%	0,3%	1.9%	X	0,3%	
DevOps	2,9%	0,1%	0,4%	5.7%	0,4%	2,2%	0,7%	X	0,4%
DesignThinking	7.1%	0,7%	0,4%	5.1%	0,4%	2,0%	1.3%	0,3%	X
Total	**53%**	6%	3%	**25%**	1%	7%	4%	1%	0%

Multiple enumeration of combinations is possible due to the admission of 5 combination patterns in the questionnaire: Note: multiple selections were allowed where possible; hence the number does not reflect the number of participants

Table 7.2 shows that Traditional Waterfall, Scrum, V-shaped Process, Kanban, and Lean project management are the most frequently mentioned project management approaches which are used in building hybrid project management. Design Thinking and DevOps, although not project management approaches in the strict sense, are regularly used in projects. Design Thinking is an iterative process to redefine solutions using prototypes to test and prove product ideas during project initiation (Projektmagazin, 2020). DevOps is a practice dedicated to creating and operating systems in rapidly changing environments along with project work (Projektmagazin, 2020). Both have been added in this survey because they were reported to often go hand in hand with project management approaches (see e.g. Helena study, 2017).

Table 7.2 provides the inputs to answer Research Question 2 “How are project management approaches combined with other project management approaches”, discussed next.

<u>Identified major hybrid patterns:</u>

Of 128 participants (which represent 18.6% of all the combination patterns) most used the traditional project management approach and combined it with Scrum e.g. by using it sequentially, in parallel or by combining the practices of both project management approaches. The reason for this can be seen in contractual aspects, which require a fixed delivery outcome, later secured by traditional Waterfall practice while keeping certain development details flexible during project execution. This is followed by Kanban project management (see below). Design Thinking, although not a project management approach per se, makes up the 3rd most often named combination pattern. The free comments indicate that this is used especially at the beginning of projects, when a product is developed to determine functionality and requirements as inputs for traditional Waterfall projects. Kanban is the second most important combination pattern (after Scrum) with traditional project management at 14.2% of the overall combination pattern and Lean project management is combined with traditional project management in 6.1% of cases. All other combination patterns are less often named at below 1% of the cases with the exception of the V-shaped model, which is combined with the traditional project management in 2,9% of the cases.

The second most important combination pattern, indicated by 71 participants or 10,3 % is the agile project management approach Scrum, which is combining Kanban project management practices on a regular basis. Similarly, to traditional project management combinations with DevOps and Design Thinking pattern is a common combination pattern representing 5.7% and 5.1% of Scrum combination efforts. From the comments in the survey again it can be derived that Design Thinking is used at the beginning of projects, when a product is developed to determine backlog items in Scrum. DevOps is mainly used for a smooth and seamless transition from a development state to a run state of the product in question.

Other combination patterns among the remaining project management approaches (V-shaped Process, Spiral Model, Scrum, Extreme Programming, Kanban and Lean PM) are minor and often below 1% of the combination patters. Hence the following can be concluded:

The main combination patterns for hybrid project management in most cases stem from Waterfall project management (53%) and use mainly Scrum and Kanban practices. The second most observed combination pattern stems from the agile project management practice Scrum and is mainly attributed to combining Kanban practices. For this the new term “Scrumban” was coined, Scrumban, combining Scrum and Kanban, is used to complete project tasks and deliver smaller products quickly: Scrumban is used when a Scrum team wants to integrate some Kanban methods in their process by focusing more on work-in-progress and continuous improvement (Reddy, 2015). This hybrid approach combines the established practices of both approaches to improve team processes and the team’s capacity to become more flexible (Timinger, 2017). Comments from the survey indicate that this creates a better balance between capacity and demand and an improved visualization of the many activities and project interdependencies. It was also highlighted by survey participants that it allows project teams to develop in the long run towards continuous improvement in project management.

The next section extends the discussion on hybrid project management by moving from *which* project management practices are combined to discuss the findings on *how* they are combined.

For this reason, question number 6 was introduced which asked how project management approaches were being combined.

Question 6: How do you combine or adjust project management approaches?

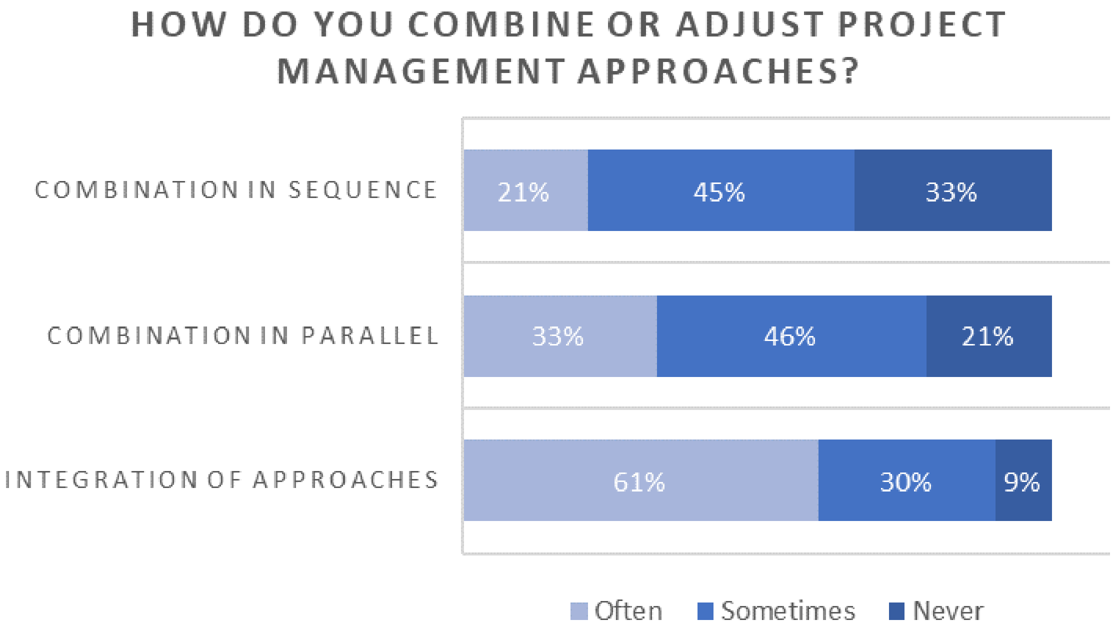


Figure 7.5 Question 6: How do you combine or adjust project management approaches?

As we saw in section 6.2, there are 3 major combination patterns for hybrid project management:

1. Sequential integration: different project management approaches are used in sequence e.g. Water-Scrum-Fall, which first uses a Waterfall project management approach to determine requirements, later an agile Scrum approach to deliver the solution and finally a repeat of Waterfall testing and closing practices.

2. Parallel integration – the use of different project management approaches at the same time: e.g. hardware development activities are used with a Waterfall approach, while software is developed with a Scrum project management approach.

3. Integrated use of different project management approaches: with the integrated approach traditional and agile project management processes, methods, tools and roles are used according to the contingency approach (see also section. 5.4)

Although the classification of combination patterns is established in the literature (see Timinger, 2017, Helena, 2017, Adelakun et al. 2017, Cooper and Sommer, 2018), research on the use of combination patterns in practice is new. Hence this research constitutes an extension of our knowledge in the field of project management on *how* different project management frameworks are combined. Based on Timinger's (2017) classification of combination pattern, the results are discussed below.

The research shows that there is quite a difference in the use of hybrid approaches (please refer to Figure 7.5). Those who indicated that they used hybrid approaches (representing 79.8% of the survey participants – see the result of question 5. Figure 7.4) – used sequential integration. Only 21% regularly used the sequential integration strategy compared to 33% who used the combination in parallel and 61% who used hybrid project management in an integrated approach.

Comparing sequential and parallel integration strategies, those who used them at times (sometimes) made up 45% and those who used both integration strategies 46% used them quite regularly. Of course, since the "Integrated use of different project management approaches" was already frequent, i.e. 61% of the time, the relative proportion is correspondingly lower at 30%. Among those who answered this question by "never", the order of approaches becomes very clear. Whereas 33% of the survey participants stated that they actually never used hybrid project management in sequence, this number was lower (21%) for the parallel use of it. A clear statement on the use of hybrid approaches can be determined for the "Integrated use of different project management approaches", which is not used often (only 9% of all survey participants). Hence, the conclusion of this finding is that actually *all integration strategies are used* in practice, with a clear *tendency towards an integrated use of different approaches* as needed.

The following section reviews the findings of the survey with regard to the project management challenges that were encountered. A link to theory and literature can be found in the main research question 3, where the project management approaches are compared using the defined CSF of the literature.

7.4 Research question 2

Which challenges get better addressed by traditional, which are better addressed by agile project management?

<u>Question 8: Of the main project management challenges that you have encountered, which ones do you believe were better addressed?</u>

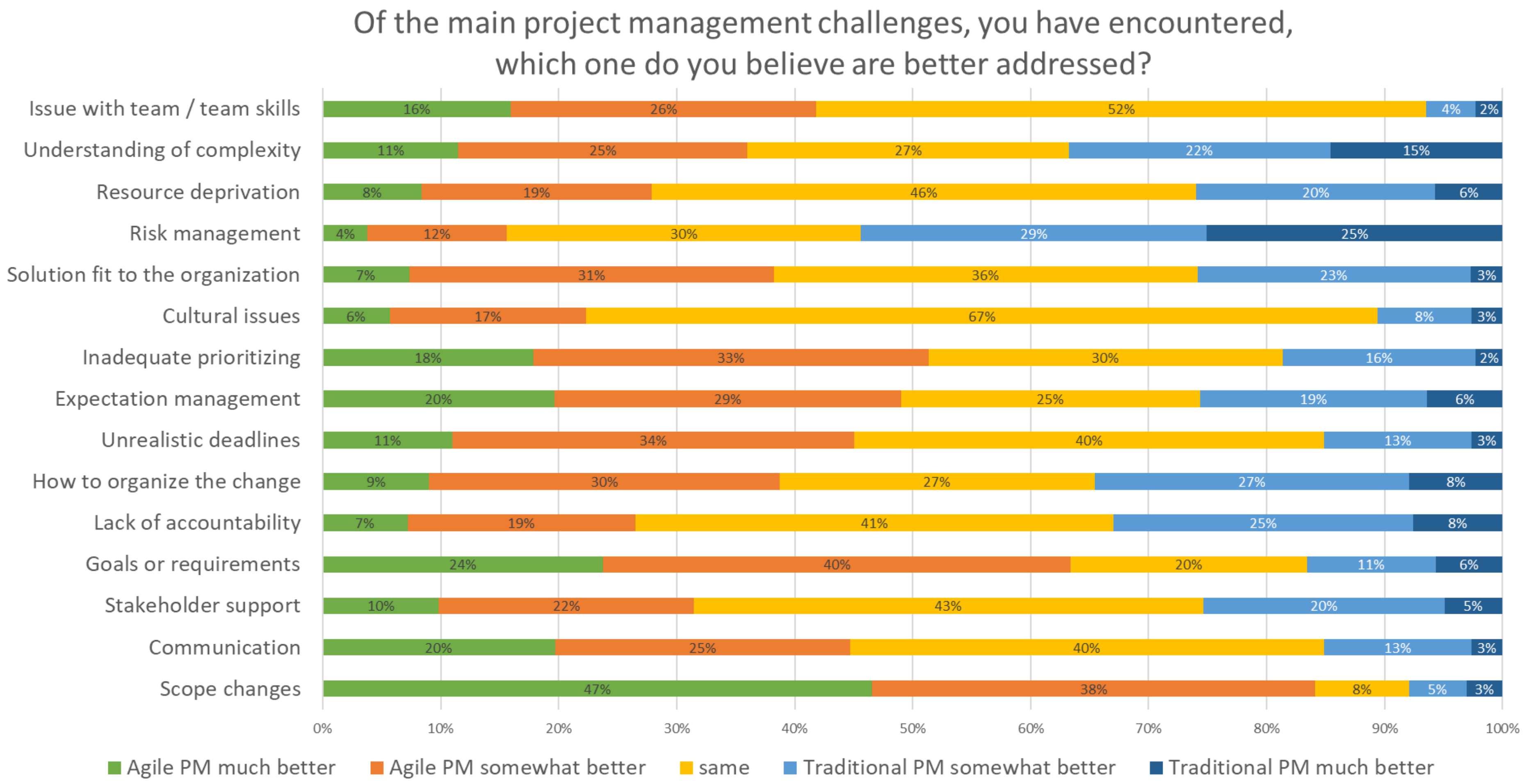


Figure 7.6 Question 8: Of the main project management challenges you have encountered, which ones do you believe were better addressed?

The question “Which challenges are better addressed by traditional, and which are better addressed by agile project management?” was asked to get better insights per factor as to when it is advantageous to use traditional and when it makes more sense to use agile project management. The following scale was used to determine the differences between traditional and agile project management:

Table 7.3 Likert Scale used for research question 2

Likert Scale				
Agile PM much better	Agile PM somewhat better	same	Traditional PM somewhat better	Traditional PM much better

In total 264 survey participants completed this section. Some of the answers have different total numbers from the participants because not every participant responded on every factor. In the following section the results of this question (see also Figure 7.6) are discussed.

Scope changes

Almost a half (47%) of all the survey participants stated that when a project has many changes of scope, agile project management is better suited to it than traditional project management. To another 38% of the participants, agile project management can tackle scope changes better; hence, 85% of the survey participants believed that agile project management is better in such situations than traditional project management. A rather small number, 8% of the participants, believed that with regard to scope changes the type of project management approach made no difference, but 8% believed that traditional project management could deal better with scope changes in projects, indicating that it dealt somewhat better (5%) or much better (3%).

Communication

20% of all the survey participants reported that in their view agile project management was much better for supporting communication. 25% of the participants thought that agile project management could tackle communication better and hence 45% of the survey participants preferred agile project management to traditional project management practices with regard to communication in projects. However, 40% of the survey participants reported that they did not believe either agile or traditional project management made any difference to the quality of communication. More than 13% responded that traditional project management approaches supported communication somewhat better and no more than 3% were convinced that traditional management in projects supported communication much better.

Stakeholder support and engagement

With regard to stakeholder support and engagement, the findings were less clear-cut. Only 10% of all the survey participants believed that agile project management addressed issues of stakeholder support much better or even somewhat better (22%). Agile and traditional project management styles were interchangeable in stakeholder support as far as 43% of respondents were concerned, whereas 25% had decided that stakeholder support was better sustained by using traditional project management practices. Of these, 20% somewhat preferred traditional practices and 5% much preferred them.

Goals or requirements

24% of all survey participants stated that in situations of undefined project goals or requirements, agile project management was much more suitable and 40% said that agile project management was somewhat better. Only 20% of the participants believed that there is no difference between agile and traditional project management. At the same time, only 11% of the survey participants stated that traditional project management was somewhat better in this regard and 6% believed that traditional project management was much better when goals or requirements are not clearly defined.

Accountability

With regard to accountability, the picture becomes slightly less clear. Only 7% of all survey participants believed that accountability issues were better addressed by agile project management and 19% reported that they were better managed by agile project management. 27% of the survey participants indicated that accountability was the same for agile and traditional project management, whereas 33% believed that the accountability on projects was better when using traditional project management practice. Of these, 25% believed this was somewhat better and 8% reported that using traditional project management was much better.

How to organise change

Opinions on how to organise change showed a wide spread. Only 9% of all survey participants judged that change was organised much better by agile project management practices and 30% judged it somewhat better at this task. 27% believed that agile and traditional project management coped equally well, while 27% found traditional project management coped rather better. Only 8% held the view that change management was much better addressed by traditional project management.

Unrealistic deadlines and planning

As regards unrealistic deadlines, 11% of the survey participants held that agile project management was much better and 34% that it was rather better than traditional project management practices. However, 40% indicated that there was no difference between the two kinds of project management. In contrast, 13% said that traditional project management was somewhat better but only 3% reported the clear superiority of traditional project management.

Clarity in expectation management

Almost half of the participants (49%) chose agile project management as either much better (20%) at expectation management, or somewhat better (29%). The fraction who believed that both project management approaches worked equally well was a quarter of this group (25%). The advocates of the traditional project management approach also made up 25%, consisting of 19% who were clear that it was somewhat better and 6% who saw traditional project management as much better.

Inadequate prioritizing

With regard to prioritizing project tasks, the result was clearer. 18% of all the survey participants considered that agile project management was much better at prioritizing project tasks and a large proportion (33%) found agile project management somewhat better, resulting in a majority who clearly preferred agile project management to traditional project management in this respect. 30% of the survey participants were indifferent which approach to project management was more successful with prioritisation. However, only 18% put traditional above agile project management, 16% who had observed it to be somewhat better and only 2% who saw its clear superiority in this matter.

Cultural issues

Referring to cultural issues, the picture is quite clear. Only 6%/17% believed that cultural issues were better/much better addressed by agile project management and only 11% thought that they fared better when the project management was traditional. The clear majority of survey participants, 67%, however, indicated that neither type of project management approach made any impact on cultural issues. This is an interesting finding of the survey: it suggests that, with regard to the "softer" issues typified by questions of culture, the selection of a project management approach seems to have no major impact and that other means, such as HR practices, need to be applied.

Fit of the solution to the organisation

Concerning solution fit, the result showed something of a split. 38% believed solution fit issues could be either much better (7%) addressed by agile project management or somewhat better (31%). Support for traditional project management came from 23% (traditional project management was somewhat better) and 3% (traditional project management was much better). 36% of the respondents, however, did not see much difference between the two in regard to this factor.

Risk management

Risk management divided the respondents' scores almost in two, unlike previous project management issues. Only 4% of all survey participants reported that agile management could be seen to tackle risk management issues much better and only 12% believed that agile project management even supposed that it was somewhat better at doing so. Even when 30% of the total found the two types of management evenly balanced on this point, it still interestingly left a majority of almost 55% to whom traditional project management seemed either better suited (30%) or much better suited (25%) when risk management became an important critical success criterion for a project.

Resource conflicts or deprivation

For resource management the result was not as clear as for previous factors. 27% of the survey participants believed that agile project management was either much better (8%) or better (19%). However, similar feedback came from proponents of traditional project management, who believed this approach was either better (20%) or much better (6%) for addressing resource issues, totalling a similar figure (26%). Almost half of the survey participants (46%) however, believed there was no difference between the project management approaches in relation to resource conflicts or deprivation issues.

Complexity

Agile project management was held by 36% of all the survey participants to address complexity issues better than its traditional counterpart (25%) or much better (11%). As far as 22% of the respondents were aware, however, this, like the previous factor, holds true also for traditional project management. An even larger group (15%) than the supporters of agile management responded that traditional project management is much better in dealing with complexity. According to 27% of the survey participants, the project management approach made no difference in this regard.

Team skills

With respect to team dynamics/team building/team skills issues, the outcome is fairly clear. An overall majority of survey participants (52%) did not rate either agile or traditional project management better on this factor. A clear outcome of this survey, however, was that traditional project management was considered to be better with team issues by only 6% of the survey participants (4% thought it somewhat better and 2% much better). Meanwhile, the adherents of agile project management provide a clear result: 42% of all the participants asserted that that agile project management tackled team issues better (26%) or much better (16%) than traditional project management, which registers as a very clear result.

7.5 Research question 3

This research question was based on question number 7 in the survey “What are the main project management challenges that you have encountered?”. 15 sub-categories which were based on the factors identified in the literature were asked about, to elicit what typical problems occurred during the survey participants’ project work.

In total 279 participants completed this section. Some of the sub-sections show different numbers because some participants answered some of the sub-questions by “don’t know/not sure” or by giving no information. The factor items were selected on the basis of project management issues identified in the literature and in the following review of the 15 project management factors they correspond to the identified groups of section 5.2. As introduced in this section (section 5.2) Organisational factors (OF), Team factors (TF), Customer and stakeholder factors (C&SF) and Project uncertainty factors (PUF) are discussed in more detail from the literature.

With this and the data of the survey in mind, a two-way approach was chosen to analyse the data in the next Chapter 8. The findings are discussed in relation to the factor itself, using the defined Critical Success Factors (CSF) from the literature (see also section 3.2). This section goes on to present the differences in these Critical Success Factors (CSF) challenges by comparing Agile (A) with Traditional (T) and Hybrid (H) project management approaches.

Is there any significant difference in Critical Success Factors (CSF) between Traditional, Hybrid and Agile project management approaches?

Hypothesis nomenclature

The following specifies whether a factor has a different characteristic due to the chosen project management approach and denotes if either traditional/hybrid or agile project management is considered to have differences in CSF challenges. The respective project management approach is juxtaposed to each factor.
</> denotes if the factor is expected to have a greater impact in terms of challenges to its project management framework (hence the project management approach is more or less sensitive to the challenges of this factor as indicated by disclosed challenges on the Likert scale).
+/- denotes the direction of this factor on the project management approach, i.e. if more of this factor has a positive (+) or negative (-) impact on the project success criteria [PSC].
# denotes that the factor has no major (neutral) impact on the project success criteria [PSC] of the respective project management approach.
e.g. T+> A+ means that the factor *has more reported issues with traditional project management compared* to agile project management. As a consequence, for the factor in question, traditional project management is considered to produce *weaker results* measured by project success criteria (PSC) in situations where this is relevant to the project. This means that the factor in question poses more reported challenges using traditional project management and as a consequence the agile project management is expected to be superior through having fewer reported challenges for this factor and vice versa.
Example 1: communication is an important factor for the delivery of projects. T+>A+ means that the factor has a positive impact on both traditional and agile project management, but the absence of communication has a higher impact on a traditionally managed project.
Example 2: More clarity in how to organise change has a positive impact on traditional projects, but for agile projects – since the clarity is obtained in the course of the project work – the impact is not substantial. Thus (T+>A#) means that, on the one hand, the higher the clarity in organising change, the better traditional projects will perform

based on PSC criteria. On the other hand, this factor has only a significant positive impact on traditionally managed projects compared with agile project management approaches, where the higher clarity has no substantial impact (is neutral), and hence is denoted as #.

7.5.1 Organisational factors (OF)

Organisational factors relate to topics that are important critical success factors (CSF) which are mainly tested by organisational circumstances. These consist of factors which support the ability to communicate, to facilitate, to manage change and to identify and manage project risks. The following section discusses organisational factors in more detail.

Communication (CO)

Communication (CO) is defined as the practices that increase the exchange of information and with this also improve cohesion not only among team members but also to other stakeholders (managers, clients/users, other departments (Finance, Business Units, Operations). Slevin and Pinto (1988) and Frey et al. (2009) identify communication in their research as an important CSF for project management as such. Ahimbisibwe (2017) points out that with the improved exchange of information, the number of team conflicts decreases which keeps a project team stable and hence has an overall positive impact on project success. Similarly, Jun et al. (2011) have found that communication has a significant positive effect on project success and Yetton et al. (2000) have shown that project team conflicts due to poor communication lead to instability in project teams and therefore to projects being delayed and exceeding the budget. This is consistent with Bredillet and Dwivedi (2009), who found that project success is dependent on stakeholder communication. Ahimbisibwe et al. (2014) assume in their research that the agile approach usually requires more personal communication and continuous interactions with management than traditional plan-based methods do; however when it is used and applied in self-organising teams, the number of issues is significantly reduced. Therefore, the following hypothesises can be defined.

CO has a critical positive effect on project management approaches (traditional, agile and hybrid): CO (A+, T+, H+) the absence of adequate communication results in a lower project management performance as measured by the Project Success Criteria (PSC) and is represented by the level of reported challenges on communication issues.

- H1a (CO). CO More communication issues are reported for traditional than for agile project management approaches CO (T+>A+).
- H1b (CO). More communication issues are reported for hybrid than for agile project management approaches CO (H+>A+).

Clarity In ways of organising change (OC) (a.k.a. Planning and Controlling)

Dvir and Lechler (2004, p .12) have found that "too many changes in project work had a negative impact on project performance: The quality of project planning affects the project success, but the major lesson is: while it is impossible to prevent project changes at all, they should be kept to a minimum". This means that a minimum planning certainty and the respective clarity in organising the change is required to ensure the successful delivery of a project. This is because many activities often have high interdependency and a change in one task may cause multiple side effects. Hence, the clearer the way of organising change is, the better the side effects can be determined and adjusted, which increases project stability and performance (Jun et al., 2011). Because agile methods deal with dynamic changes and uncertainty management better than traditional projects (Wysocki, 2019), it can be hypothesised that

OC has a critical positive effect on traditional project management approaches (traditional and hybrid) and a neutral effect on agile approaches OC (A#, T+, H+): The absence of adequate clarity results in a lower project management performance as measured by Project Success Criteria (PSC) and is represented by the level of reported challenges regarding the clarity in organising change. Hence it can be hypothesised that

- H2a (OC). More "clarity in how to organise change" issues are reported for traditional than for agile project management approaches OC (T+>A#).

- H2b (OC). More “clarity in how to organise change” issues are reported for hybrid than for agile project management approaches OC (H+>A#).

represented by the lower level of reported challenges in organising change. The neutrality of agile project management was reported by Ahimbisibwe et al. (2017) and is incorporated in this hypothesis.

Risk management (RM)

Risk management identifies the risks of a particular project and makes issues transparent by identifying the roles and responsibilities of those who participate in risk identification, which tools will be used and how risks are reported (De Bakker et al., 2010). De Bakker et al. also describe how risk management contributes to project success and states that risk management planning has a positive impact on the ability to predict project success: “Both technical risk factors and organisational risk factors, such as senior management support and user participation, are highly influential” on project success. Fabricius and Büttgen (2015) research the behaviour of the project manager with reference to risk expectation and conclude that the ability to realistically evaluate project risks makes a significant contribution to the overall project success rate.

Because agile methods treat risk by increased agility (reacting to situations rather than mitigating them upfront) and not by the traditional project management approaches to risk management of increased procedures, reporting and contingency plans, it can be assumed that there is less risk management in agile projects due to the lack of formality in this regard.

RM has a critical positive effect on project management approaches (traditional, agile and hybrid) RM (A+, T+, H+): The lack of risk management results in a lower project management performance as measured by Project Success Criteria (PSC) and is represented by the level of reported challenges based on improper risk management/contingency plans (Walczak and Kuchta, 2013). Hence it can be hypothesised that

- H3a (RM). More risk management issues are reported for agile than for traditional project management approaches RM (A+>T+).

- H3b (RM). More risk management issues are reported for agile than for hybrid project management approaches RM (A+>H+).

represented by the lower level of reported challenges in organising change.

7.5.2 Team factors (TF)

Many researchers differentiate between project-related outcomes (i.e. the magic triangle (see Section 3.2.2.) and people-related outcomes (e.g. team member satisfaction, viability of the team). However, people-related topics are not only critical success criteria (PSC) of projects but also important critical success factors (CSF) (Müller and Jugdev, 2012). Hoegl and Gemünden (2001) show that team factors are among the most critical success factors in projects. The following section discusses team factors in more detail.

Accountability (AC) (a.k.a. team commitment)

The amount of mutual understanding in the project context and the perception of the individual contributions controls the quality of the teamwork that a team demonstrates: While teams need to work together and cooperate on basic aspects of a common task (see also team dynamics/team building (TD)), many activities are individual tasks which need to be delegated to individual members who work on parallel subtasks complementarily (Hoegl and Gemünden, 2001). An important element for the quality of teamwork is the reliability of individuals with responsibilities, and the synchronization and harmonization of these individual contributions (Hoegl and Gemünden, 2001) which is represented by the Accountability (AC) factor.

Because agile methods rely more on self-organising teams than traditional project management approaches do, it can be hypothesised that

AC has a critical positive effect on project management approaches (traditional, agile and hybrid) AC (A+, T+, H+): The lack of accountability results in a lower project management performance as measured by Project Success Criteria (PSC) and is represented by the level of reported challenges on team accountably/commitment. Hence it can be hypothesised that

- H4a (AC). More team accountability issues are reported for agile than for traditional project management approaches RM (A+>T+).
- H4b (AC). More team accountability issues are reported for agile than for traditional project management approaches RM (A+>H +).

represented by the lower level of reported challenges on organising change.

Team building/dynamics (TD) (a.k.a. team composition, cultural issues)

Whereas Accountability (AC) focuses on the reliability of individuals with responsibilities, Team dynamics/team building (TD) describes the cooperation, information exchange and cohesion among team members (Ahimbisibwe et al. 2017). Jun et al (2011) found that there is a positive relationship between team dynamics and project performance. Equally, Yetton et al. (2000) found that team conflicts have a negative impact on project success, resulting in negative impacts on the “magic triangle” criteria of project success. Hoegl and Gemünden researched in depth team effectiveness, team efficiency, team member engagement and learning aspects in projects. As a result of their research, Hoegl and Gemünden (2001) define the following constructs for team factors:

1. Contributions, representing a balance of team member contributions and the chance of team members being able to bring in their expertise to its full potential;

2. Mutual support, including the likelihood of team members helping and supporting each other in carrying out project activities;
3. Effort, representing all the effort that team members exert for the project tasks;
4. Communication, which assesses whether information exchange is sufficiently frequent, informal, direct, and open; and Coordination, which shows whether individual efforts are well structured and synchronized within the team;
5. Cohesion, representing the ability of a team to remain motivated and to maintain team spirit.

The findings correspond to similar research conducted by Shokri-Ghasabeh and Kavousi Chabok (2009), Mir and Pinnington (2013), Jun et. al (2011) and Xu et al (2010). Hence, the factors were represented by Team dynamics/team building (TD) factors in this research. According to Ahimbisibwe et al. (2017, p. 407) “agile methodologies tend to require more face-to-face communication … short meetings within teams and continuous interactions with management than traditional plan-based methodologies do.” Therefore, agile methods rely more on self-organising teams than traditional project management approaches do; this however is embedded in the agile philosophy, approaches and training. Hence it can be hypothesised that

- H5a (TD). More team dynamics/team building issues are reported for traditional than for agile project management approaches TD (T+>A+).
- H5b (TD). More team dynamics/team building issues are reported for hybrid than for agile project management approaches TD (H+>A+).

represented by the lower level of reported challenges with regard to team dynamics/team building issues.

Team skills (TS)

Handzic et al. (2013) find that a qualified team has a positive impact on project performance, especially if formal project manager training is given and competence available in the project and the project team. The empirical results of Mir and

Pinnington (2013) support the finding that investment in the training and qualification of team members has a positive impact on project success and can be seen as an indicator of project performance. Similarly, Arumugam et al. (2013) have found that learning and knowledge creation in project teams (here, Six Sigma projects), and technical support to the project team and social learning practices in teams increases knowledge in these teams and has a positive impact on project performance.
Agile project management normally relies more on a smaller sized team who are self-organising with suitable skills and expertise in the specific subject-matter than on traditional project management approach methodologies: Agile teams on average are more skilled and hence issues with team skills tend to be more prevalent in traditional project management (Ahimbisibwe et al., 2017, p.407). Therefore, the following hypothesis is proposed:

- H6a (TS). More team skills issues are reported for traditional than for agile project management approaches TS (T+>A+).
- H6b (TS). More team skills issues are reported for hybrid than for agile project management approaches TS (H+>A+).

represented by the lower level of reported challenges with regard to team skills issues.

7.5.3. Customer & stakeholder factors (C&SF)

Customer & stakeholder factors indicate how well customer and other stakeholder are integrated in the project management approach because this has been identified as a major category among success factors. The following section discusses this in more detail.

Stakeholder support and engagement (SS)

In multiple project management research, stakeholder support and engagement has been identified as one of the primary success factors for projects (see Aguanno (2005), Alexandrova and Ivanova (2013), Ahimbisibwe et al. (2015), Mir and Pinnington (2013), Shokri-Ghasabeh and Kavousi-Chabok (2009)) and it has been found that stakeholder support and engagement have a positive impact on project performance. Stakeholders are individuals or organisational units who have a vested interest in a project and can with their influence have an impact on its success (or failure) (PMI, 2017). Agile project management normally relies on customer focused teams (e.g. as presented by the product owner) and hence have a stronger stakeholder integration than traditional project management approach methodologies do (Ahimbisibwe et al., 2017). Therefore, the following hypothesis is proposed:

- H7a (SS). More stakeholder support and engagement issues are reported for traditional than for agile project management approaches SS (T+>A+).
- H7b (SS) More stakeholder support and engagement issues are reported for hybrid tan for agile project management approaches SS (H+>A+).

represented by the lower level of reported challenges with regard to stakeholder support and engagement issues.

Goals or requirements (GR) (a.k.a. project mission)

A clear and realistic definition of the project goals or requirements should be worked out in the project definition and be part of the project initiation process and its documents (PMI, 2017). At the end of a project, the project goal is compared with the project result. ISO 21500:2012 defines the project goals as “measurable benefits that contribute to realizing the selected opportunities” ISO (2012). The project objectives are also documented in the project manual in order to be available to the entire project team and its stakeholders, which is important for focusing on the activities required to complete the project successfully. Müller and Jugdev (2012) also name this ‘project mission’.

Ika et al. (2012) have found that clearly defined goals and requirements directly impact positively on project performance. Likewise, Serra and Kunc (2014) and Taherdoost and Keshavarzsaleh (2016) have found evidence that the clear definition of project requirements supported by well-structured plans aligned with the overall project objectives lead to improved project success. As we have seen in section 4.3 on Agile project management, agile projects tend not to emphasise clear goals or requirements due to their embedded approach to dynamic changes (hence their impact on agile project management is less). Therefore:

- H8a (GR). More goals or requirements issues are reported for traditional than for agile project management approaches GR (T+>A+).
- H8b (GR) More goals or requirements issues are reported for hybrid than for agile project management approaches GR (H+>A+).

represented by the lower level of reported challenges with regard to goals or requirements issues.

Solution fit to the organisation and its stakeholders (OS)
(a.k.a. stakeholder or user participation)

(OS) measures whether a solution fits in with the organisation (stakeholders) and its culture. According to Ahimbisibwe et al. (2017), who researched customer factors in software development projects, the literature reveals that OS increases the likelihood that a project will succeed. Although one can argue that OS tends to require more budget by encouraging suggestions for project changes to the specification, Yetton et al. (2000) have found that OS also reduced budget variance by meeting expectations and swiftly addressing and solving project problems. Jun et al. (2011) have also shown that the early resolution of potential conflicts results from greater stakeholder involvement.
Ahimbisibwe et al. (2017, p. 408), states that agile projects require on-location and full-time stakeholder integration "from the specification phase to the end". Yet traditionally managed projects do not necessarily permanently integrate a stakeholder feedback loop and hence a solution fit to the organisation and its stakeholders may be missed.

- H9a (OS). More organisational solution fit issues are reported for traditional than for agile project management approaches OS (T+>A+).
- H9b (OS) More organisational solution fit issues are reported for hybrid than for agile project management approaches OS (H+>A+).

represented by the lower level of reported challenges with regard to goals or requirements issues.

Clarity in expectation management and deliverables (EM)

According to International Standardization Organisation (ISO) project goals are defined as the aggregation of the individual project objectives that are achieved by the project by creating the defined and required deliverables. Project might he clear objectives, but are not well aligned with what is expected, which can be a major driver of project failure (stakeholder feel that the result is not what they have expected or envisioned). Hence, EM is measuring what a project (outcome) delivers relatively what is expected. Previous researches have shown that client experience and expectation play a positive role in project success. Handzic et al. 2013 found that active management of customer relationships and interaction has a positive impact on project process. Jun et al. (2011) concluded from empirical evidence that user participation in (software) projects that conflicts and risk of negative customer satisfaction can be reduced by involving the parties concerned. Müller and Jugdev (2012) concluded that end-user participation in project work makes a positive contribution to project success. In addition, Ahimbisibwe et al. (2015) found that, once involved deeply in the project topics of what the project delivers, customers or end-users are willing to participate more in the project activities and are supportive in executing the project when questions and issues with a positive impact on project performance arise. This is more prevalent in agile approaches because in an agile set-up the product owner pre-determines the integration of customer needs, as seen above in section 4.3. However, agile approaches have a downside: they are designed to give upfront no exact definitions of the deliverables (Rubin, 2012). Hence agile methodologies are more likely to integrate customers and customer needs in the project activities than traditional approaches are; the converse is also true. However, the agile approach does not specify exactly what the project will deliver; this is kept flexible (see Wysocki, 2019). Hence what is expected and its deliverables are less clear.

For this reason, the following is hypothesised:

- H10a (EM). More expectation management and deliverables issues are reported for traditional than for agile project management approaches EM (T+>A+).
- H10b (EM) More expectation management and deliverables issues are reported for hybrid than for agile project management approaches EM (H+>A+).

represented by the lower level of reported challenges with regard to issues of expectation management and deliverables.

7.5.4 Project uncertainty factors (PUF)

Project uncertainty factors are factors describing how well project uncertainties are integrated in the project management approach. This has been identified as a major category in success factor. The following section discusses project uncertainty factors in more detail.

Scope changes (SC) (a.k.a. specification changes)

Especially in product developments, new findings arise in the course of developing a project that can contribute to change in the product or project delivery. Innovations or new insights after the start of a project imply that more features or features, unlike those originally planned, need to be incorporated in the project delivery. Quite often customers only realise during the course of a project that additional functionalities or features are required. If changes are not included in the original definition of the project, scope changes (SC) must be incorporated during the course of the project.

Typically, neither the project budget nor the planned project duration allow these changes to be incorporated, which often results in disputes and disagreements since they were not calculated in the originally and contractually agreed delivery, price or project completion date (see Section 3.1. Project Success Criteria).

Boehm and Turner in their early research comparing agile and plan-driven methods reported that scope changes have a negative influence on project performance, as subsequent findings confirm (Anbari, 2003, Munassar and Govardhan, 2010, Schopka, 2015, Conforto et al., 2016, Chow and Chao 2008). Dvir and Lechler (2004) found that constant project goal and plan changes impair the y quality of the planning: "The quality of the Planning has the highest positive direct effect on efficiency, while goal changes have the highest negative direct impact on customer satisfaction" (p. 10). Still, Ahimbisibwe et al (2015) report that agile projects are likely be more successful if the rate of change of requirements is high, because they have been specifically designed to cope with the problems of rapid change. This is because iterative project execution helps to reduce uncertainty and leads projects through the uncertain effects of customer input (Lemétayer, 2010). This contrasts with traditional project management approaches that plan ahead for each task. Many of these plans are dropped when changes occur, as Wysocki (2014) found; see his proposed "Project Management Life Cycle models (PMLC)" which adjust in response to uncertainty. In situations of minimal scope change, where no or only a few changes are expected during the project life-cycle, it is hypothesised that the traditional methodology works best, since there is no need to change the plan.
Therefore, the following hypotheses are defined:

- H11a (SC). More scope changes issues are reported for traditional than for agile project management approaches SC (T->A-).
- H11b (SC) More scope changes issues are reported for hybrid than for agile project management approaches SC (H->A-).

As represented by the lower level of reported challenges with regard to expectation management and deliverables issues.

Prioritizing of task and activities (PT)

For efficient project management, a focus on the prioritisation of task and activities is crucial, otherwise project work will be carried out inefficiently and ineffectively. Prioritization means the evaluation of similar tasks and project activities on a standardized scale and subsequently sorting them according to clearly defined criteria, resulting a clear sequence which in traditionally organised projects cannot easily be changed. The purpose of prioritization is to determine the most important elements for a particular goal (for example, tasks, activities, sub-projects etc.) and representing them in an overall project plan. This is supposed to maintain planning reliability so that subsequent interdependencies (e.g. contracts and other obligations) can be managed more easily.

As we saw in section 4.4, the difference from traditional prioritisation is that agile project management regularly reviews the scope and priorities of the project, based on the overall sprint planning, which is central to the agile project management approach. Since each review involves a dedicated prioritization based on the needs of the business, it has the advantage of allocating the highest business value and need to the project work (Racheva et al., 2010. O'Sheedy, 2012). An important influencing factor is the "Business Value" of the backlog items (Cobb, 2015). Agile development focuses on the requirements with the highest value for the product consumer. Most value-adding requirements should be prioritized, implemented and introduced into productive use as early as possible (Cobb, 2015). In this way, new findings can be incorporated into the implementation without delay during regular operation. Concentrating on the business value of a task ensures that the available capacity is always used optimally (Racheva et al., 2010). In contrast, traditional project management assumes a predictable environment and relies on planning tools that are best suited to optimizing the management of a project in a rather static environment. These approaches are usually inflexible and therefore must focus on adherence to plan as a measure of success (Wysocki, 2019). Hence, the following hypotheses are defined:

- H12a (PT). More prioritizing of task and activities issues are reported for traditional than for agile project management approaches PT (T+>A+).

- H12b (PT) More prioritizing of task and activities issues are reported for hybrid than for agile project management approaches PT (H+>A+).

represented by the lower level of reported challenges with regard to the prioritizing of task and activities issues.

Resource conflicts or deprivations (RC)

Resource management is the disposition of the manpower, machines, tools and other resources required for project work. Sometimes the term 'resource management' is used to describe only the planning of employee deployment for project work. According to Shokri-Ghasabeh and Kavousi-Chabok (2009), the availability of resources is one of the most critical factors in project success. The effective project management life-cycle requires the effective allocation and re-allocation of resources. Hartman and Ashrafi (2002, p.10) conclude similarly that "throughout all project phases, there was general agreement among survey participants that a project mission, consultation good communication, and the availability of resources are important factors for project success". Because of the way agile teams work (see Section 4.3), some proponents have suggested that resource management is embedded in the agile approach and hence its dedicated management, as is common in traditional project management, is not so much needed (Adam and Prostean, 2013).

Therefore,

- H13a (RC). More resource conflicts or deprivations issues are reported for traditional than for agile project management approaches RC (T->A-).
- H13b (RC) More resource conflicts or deprivations issues are reported for hybrid than for agile project management approaches RC (H->A-).

represented by the lower level of reported challenges with regard to the prioritizing of task and activities issues.

Planning and deadlines (PD) a.k.a. level of project planning

Project planning is the process of planning the scope, costs, resources, quality and other critical aspects of a project (see Section 5.1 Project Success Criteria).
Project planning and deadlines relate to the extent of project planning and controlling practices used in a project (Ahimbisibwe et al., 2017). Research has shown that the planning and monitoring of deadlines has a positive impact on project performance (Yetton et al., 2000). Insufficient planning of milestones, task and sub-activities are likely to be associated with inefficiencies in project execution, resulting in large gaps in project performance as represented by the "magic triangle" (time, cost, performance) (Jun et al., 2011). Moreover, Misra et al. 2009 found that the consistent tracking and monitoring of a project activity according to a previously defined project plan can ensure that the final project is delivered within budget and on time (Ahimbisibwe et al., 2017). Interestingly, other research evidence shows no significant relationship between the unformalized project plans as used in agile approaches and the success of agile projects (Misra et al. 2009 in Ahimbisibwe et al., 2017). However, it has been argued that plans and controls for agile projects easily become obsolete, since changes are usually made faster than they can be updated and hence the complex and fast changing project environment makes planning unsuitable (Ramesh et al., 2012).
Hence it is suggested that:

- H14a (RC). More planning and deadlines issues are reported for traditional than for agile project management approaches RC (T+>A+).
- H14b (RC) More planning and deadlines issues are reported for hybrid than for agile project management approaches RC (H+>A+).

represented by the lower level of reported challenges with regard to planning and deadlines issues.

Complexity and interdependencies (CI)

Complexity refers to the project management system and its environment, whose many components can interact with each other in different ways. The more components are connected in multiple ways and the more rules and standards are established, the greater the complexity. Over the last decade, the complexity and dynamics of project environments have reached a new level, especially with the use of new technologies which get replaced faster than ever before, increasing the uncertainly (Howell et al., 2010). To give only one example, classic music records were replaced, first, by CDs, then by mp3 and more recently by streaming services. The increase in complexity has shown the limitations of traditional project management concepts, which is why agile project management emerged (Serrador and Pinto, 2015). Some claim that in instances of high complexity and rapid change, traditional project management approaches are no longer effective (e.g. Sanchez et al., 2019, Conforto et al., 2016, Boehm and Turner (2004). In contrast, agile development methods were designed to react to changing and uncertain requirements and to reduce the costs of change during a project (Cockburn and Highsmith, 2001). According to Ahimbisibwe et al. (2017), new technology projects cannot be planned well in advance and a key success factor is whether a team can "adapt as they learn" during project execution: "Gradual learning is better suited for agile methods, as they use short iterations and constant feedback". Therefore, the following is hypothesised:

- H15a (CI). More complexity issues are reported for agile than for traditional project management approaches CI (A->T-).
- H15b (CI) More complexity issues are reported for hybrid than for agile project management approaches CI (A->H-).

represented by the lower level of reported challenges with regard to complexity and interdependencies issues.

<u>Summary of Critical Success Factors in Projects, research hypothesis and measurement/definitions</u>

Table 7.4: Overview of hypothesis

Category	Critical Success Factor in Projects	Hypothesis	Direction	Measurement/Definition
Organisational factors (OF)	1. **Communication** (CO)	H1a (CO): (T+>A+) H1b (CO): (H+>A+)	T+, H+, A+	Communication (CO) is defined as the practices that increase the exchange of information and with this also improve cohesion not only among team members but also with other stakeholders. More communication is better for project work (+)
	2. **Clarity in how to organise change** (OC) a.k.a. Planning and Controlling, monitoring and controlling	H2a (OC): (T+>A#) H2b (OC): (H+>A#)	T+, H +A#	Clarity in ways of organising change (OC) is defined as planning certainty and the required clarity in organising change to ensure the successful delivery of a project. More clarity in organising change is better for traditional project results (+) but neutral for agile project management (#)
	3. **Risk management** (RM)	H3a (RM): (A+>T+) H3b (RM): (A+>H+)	T+, H+, A+	Risk management (RM) identifies the risks of a particular project and makes issues transparent by identifying the process, roles and responsibilities which are part of risk identification and mitigation. More risk management is better for project results (+)
Team factors (TF)	4. **Accountability** (AC) a.k.a. team commitment	H4a (AC): (T+>A+) H4b (AC): (H+>A+)	T+, H+, A+	Accountability (AC) is the ability of a team to structure and manage *individual* project tasks which need to be delegated to individual members who work complementarily on parallel subtasks. More accountability of the team is better for project results (+)

	5. **Team dynamics/team building** (TD)	H5a (TD): (T+>A+) H5b (TD): (H+>A+)	T+, H+, A+	Whereas Accountability (AC) focuses on the reliability of responsible individuals, Team dynamics/team building (TD) describes the cooperation, information exchange and cohesion *among team members.* More team building of the project team is better for project results (+)
	6. **Team skills** (TS)	H6a (TS): (T+>A+) H6b (TS): (H+>A+)	T+, H+, A+	(TS) describes the qualification of the team for a certain project task or activity, i.e. the competence available in the project and for the project team. More team skills on the project team are better for project results (+)
Customer & stakeholder factors (C&SF)	7. **Stakeholder support and engagement** (SS)	H7a (SS): (T+>A+) H7b (SS): (H+>A+)	T+, H+, A+	(SS) Stakeholders are individuals or organisational units who have a vested interest in the project. The quantity and the perceived power of positive supporters is used to define this measure. More stakeholder support and engagement are better for the project result (+)
	8. **Goals or requirements** (GR) a.k.a. project mission	H8a (GR): (T+>A+) H8b (GR): (H+>A+)	T+, H+, A+	A clear and realistic definition of the project goals or requirements (GR) should be worked out in the project definition and be part of the project initiation process and its documents. More clearly defined goals or requirements are better for the project result (+)
	9. Determining which **solution fits in with the organisation** and its stakeholders (OS)	H9a (OS): (T+>A+) H9b (OS): (H+>A+)	T+, H+, A+	(OS) measuring if a project outcome (solution) *fits in with* the organisation (stakeholder, users) and its culture. More clarity in solution fit is better for the project result (+)
	10. **Clarity in expectation management and deliverables** (EM)	H10a (EM): (T+>A+) H10b (EM): (H+>A+)	T+, H+, A+	(EM) measures *what a project* (outcome) *delivers* relatively what is expected. More clarity in what is expected and should be delivered is better for the project result (+)

Project uncertainty factors (PUF)	11. **Scope changes** (SC) a.k.a. specification changes	H11a (SC): (T->A-) H11b (SC): (H->A-)	T-, H-, A-	If changes are not included in the original definition of the project, scope changes (SC) need to be incorporated during the course of the project. The more the scope of a project changes, the more issues occur; hence it has a negative impact on the project result (-)
	12. **Prioritizing of task and activities** (PT)	H12a (PT): (T+>A+) H12b (PT): (H+>A+)	T+, H+, A+	Prioritizing of task and activities (PT) is done to determine the most important elements for a particular goal (for example, tasks, activities, sub-projects etc.) and represent these in an overall project plan. More prioritization of task and activities is better for the project result (+)
	13. **Resource conflicts or deprivations** (RC)	H13a (RC): (T->A-) H13b (RC): (T->A-)	T-, H-, A-	Resource conflicts (RC) are distribution issues on the availability of manpower, machines, tools and other resources required for project work. More resource conflicts imply weaker project results (-)
	14. **Planning and deadlines** (PD) a.k.a. level of project planning	H14a (PD): (T+>A+) H14b (PD): (H+>A+)	T+, H+, A+	Project planning and deadlines relate to the extent of project planning and controlling practices used in a project. More planning of tasks and activities imply better project results (+)
	15. **Understanding of complexity and interdependencies** (CI)	H15a (CI): (A->T-) H15b (CI): (A->H-)	T-, H-, A-	Complexity and interferences refer to the project management system and its environment whose many components can interact with each other in different ways. The more components are connected in multiple ways and the more rules and standards are established, the higher the complexity can get. Research shows that the higher the complexity, the more project interdependencies occur, increasing the likelihood of issues with weaker project results (-)

T= Traditional project management, H = Hybrid project management, A = Agile project management
+ = factors have a positive impact on project management performance measured by Project Success Criteria (PSC);
- = factors have a negative impact on project management performance measured by Project Success Criteria (PSC);
= factors have no significant impact on project management performance measured by Project Success Criteria (PSC)

8. Discussion of findings on project management issues and difference in project management approaches

In the following chapter the core of this research is presented. Research Question 3 is the key research question which is discussed in detail below.

This section is organised as follows: first an overview of the data is provided by means of a bar diagram (see Figure 8.1) showing the data and the 15 factors that were theoretically described. The survey results are broken down in percentages on a Likert scale. Graphical differences for each factor can already be observed. In order to be able to use statistical inference, the Likert scale is been quantified from 1 to 5 as shown in Table 8.1, with guidance in reading the statistical analysis. The section for each factor has two parts: the significance section (part 1) and the analysis section (part 2). Insights on the significance of each factor are followed by an overview of the results of the hypothesis formulated in section 7.5. After the overview, all 15 factors in turn are discussed in detail. This chapter then concludes by summarising the key findings of all three research questions.

Chapter 9 will introduce a correlation analysis to complement the findings of the 15 factors researched and will give some additional insights in the interdependencies among the Critical Success Factors (CSF) themselves. This will help project managers to identify factors which develop in concert and hence support project managers to identify and derive a bundle of activities to optimize the project management activities and the approach chosen.

The final chapter, Chapter 10, provides a conclusion to the findings, the limitations of this study and recommendations for future research.

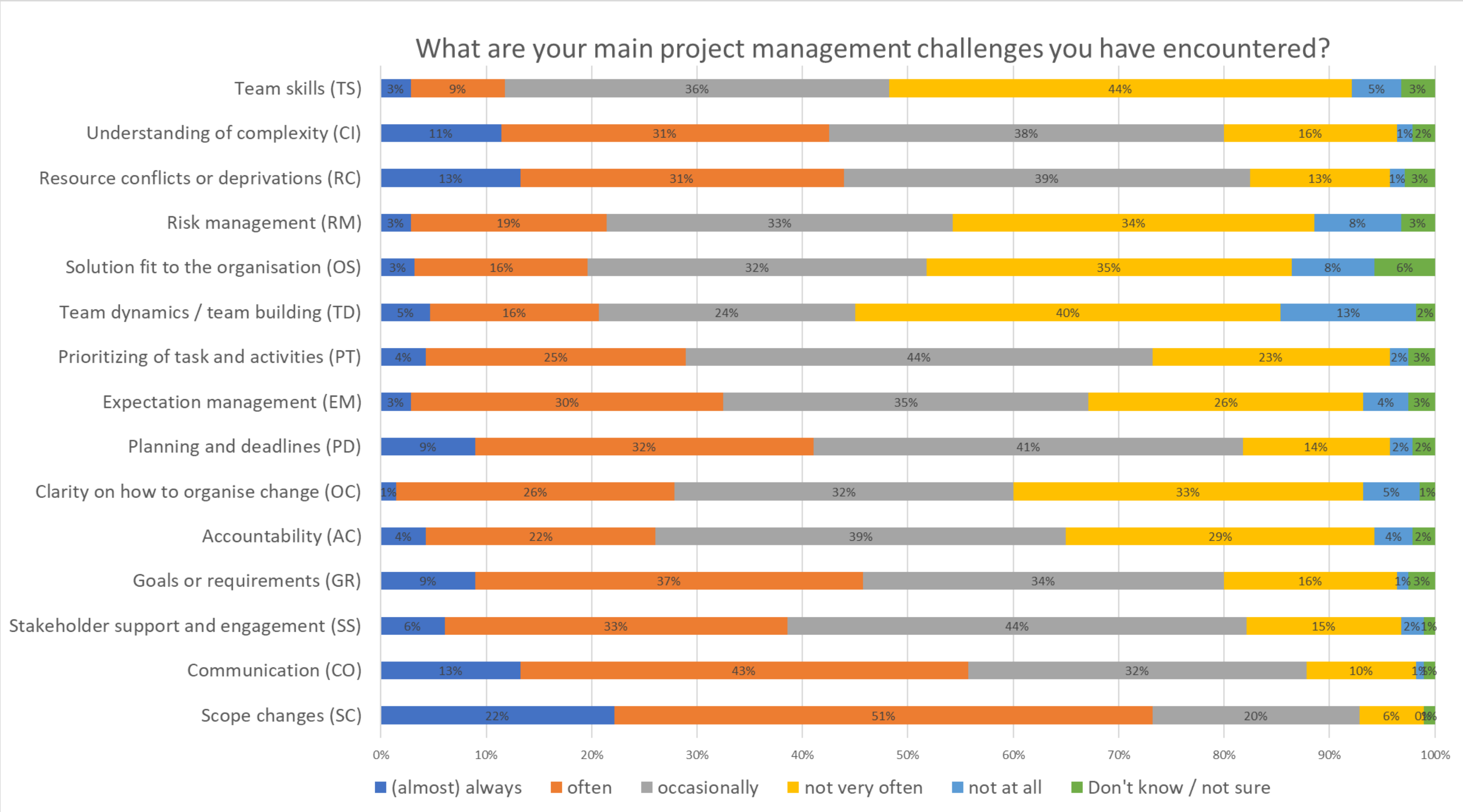


Figure 8.1 Question 7: What are the main project management challenges that you have encountered?

In the following section *each* Critical Success Factor (CSF) discussion is structured in two parts. In part 1 the significance of each factor is discussed, and the next deals with differences between traditional, hybrid and agile project management approaches. The following figure, Figure 8.2, graphically represents the two-tier approach.

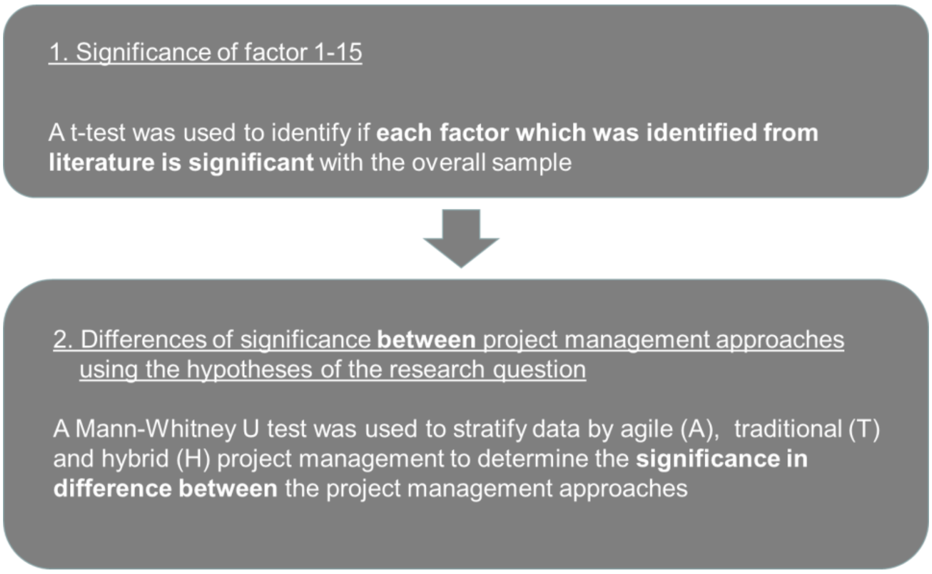


Figure 8.2: 2-tier approach of factor significance and differences in project management approaches

Significance of the factors (part 1)

In first section of each factor, the significance on a Likert scale in the collected data is discussed. A t-test was carried out for each factor and a summary of all the factors can be found in Appendix 4.

With regard to individual significance testing per factor, each factor can be considered significant if the hypothesised average mean is significantly less than 4, representing an average mean which indicates that most of the survey participants knew from experience and clearly considered that this factor was relevant by indicating that it raised issues either always, often or occasionally on projects. The hypotheses are defined as follows:

Null hypothesis (H_0)

There are not many <factor of Hx> issues; hence a mean greater than 4 (either not very often or not at all)

Alternative Hypothesis (H_1)

On projects there are <factor of Hx> issues quite often; hence a mean significantly less than 4 (='always' 'often' or occasionally')

Likert Scale				
1	2	3	4	5
always	often	occasionally	not very often	Not at all
= supportive			= not supportive	
Issue with success criteria from Hypotheses H1-H15 (= an important success criterion)				

Table 8.1: Likert scale used in the survey with numeric representation

For the significance testing the mean was set to greater than or equal to 4. A factor was considered significant when the test resulted in a significance smaller than 0.05. In this case the Null hypothesis (H0) was rejected (that there are not many <factor 1 to 15> issues) and the alternative hypothesis (H1) was accepted, that there are serious <factor 1 to 15> issues and these can be considered prevalent in project management. A factor which is prevalent has a negative impact on the project success as measured by the Project Success Criteria (PSC) – please refer Chapter 3 and to Appendix 4 for an overview of the completed one sample t-test and the results from SPSS[49].

Differences between traditional, hybrid and agile project management approaches (part 2)

The difference when comparing factors is broken down by project management approach – i.e. agile, hybrid or traditional – to investigate if differences of factors exist when different project management approaches are used, based on the hypotheses in section 7.5. Research Question 3.

For this analysis a Mann-Whitney Test was used. The Mann-Whitney U test is carried out primarily when the data are scaled ordinally, such as when a Likert scale is used to rank categories (Bartlett, 2014). For the present research a 5-point scale was used to indicate how often each factor could be observed in the respondent's project management work: always, often, occasionally, not very often, not at all (see also the example above). As the data had been stratified into three project management approaches, agile, hybrid and traditional, the sample size for each group decreased significantly, which made a t-test less suitable, especially when the data were not normally distributed (Bartlett, 2014). When to use a t-test and when it is more appropriate to use the Mann-Whitney test is a matter of academic dispute (see e.g. Fay and Proschan (2010), Bartlett (2014), Divine et al. (2018)). The Mann-Whitney U-test is used to verify that two independent samples are from the same population. Practically speaking, the independent variable represents two or more groups (in our case the project management approaches of agile, hybrid and traditional). Although the t-test is considered very robust and has been used to determine the significance of the factors in the present study, the decision was made to use the Mann-Whitney Test for comparing different project management approaches, due to the reduced size of the sample. One important assumption made for the t-test is that the data are normal and normally distributed (Jankowicz et al. 2016b). This is an important assumption, which should be especially considered when the sample size is rather small (Bryman and Bell, 2011). The means of data with a large population tend to be normally distributed as stipulated by the central limit theorem. The central limit theorem justifies the phenomenon that the additive means of many small independent samples follow a roughly normal distribution (Johnson, 2004). For smaller samples with ordinal data, this assumption should be treated with more caution (Jankowicz et al., 2016b). The data for analysing the project management approaches does not share this assumption of normality (see Appendix 5: test for normality). Hence, it was decided to use the Mann-Whitney U-test statistic for the analysis of research question 3: "Is there any significant difference in Critical Success Factors (CSF) between the Traditional, Hybrid and Agile project management approaches?".

For this research, the significance threshold was set at P =0.05. The CSFs are considered in turn in the following section.

The section should be read as follows (please refer to the table on the next page which shows in more detail how findings are summarized and how each factor is discussed):

Table 8.2: Overview of analysis approach for request question 3.

<table>
<tr>
<td><u>Significance of the factors (part 1)</u>

Sub-section per factor 1-15 in this Chapter</td>
<td>Where to find?</td>
</tr>
<tr>
<td>

<u>1. Significance of factor 1-15</u>
A t-test is used to identify if **each factor which was identified from literature is significant** using the overall sample

Discusses significance of each factor
Example here: factor Communication (CO)

</td>
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For each factor, the overall significance is discussed under the heading Significance of the <factor>.

Below please see the **example for the factor defined as "Communication (CO)"**

11.1 → Communication (CO)

Significance of Communication (CO)

The analysis of Communication (CO) factor's mean equal to or greater than 4 has a significance of 0 hence the Null hypothesis (H0) is rejected (that there are not many Communication (CO) issues) and the alternative Hypothesis (H1) is accepted that there are serious communication issues and they are quite prevalent. This has a negative impact on the project success as measured by the Project Success Criteria (PSC).

	t	df	Sig. (2-tailed)	Mean Difference
Communication (CO)	-29,989	276	**0,000**	-1,578

Figure 44: Significance of the factor Communication (CO)

The analysis of *each* factor's mean was set to equal or be greater than 4. All of the factors had a significance of 0; hence the Null hypothesis (H0) is rejected (in this example, where there are not many Communication (CO) issues) and the alternative Hypothesis (H1) is accepted that there are serious communication issues and they are quite prevalent. This has a negative impact on the project success as measured by the Project Success Criteria (PSC). This holds true for all the 15 factors considered in this research.

In the summary table below the result can be found (marked in yellow):

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The summary of results can be found here
Example: factor Communication (CO)

Category	Critical Success Factor in Projects	Support of factor[49]	% Supportive (Likert)[50]
Organisational factors	1. **Communication** (CO)	Yes	+ 88,8%
	2. **Clarity on how to**	Yes	o

Differences between traditional, hybrid and agile project management approaches (part 2)

Data were then stratified by project management approach as typical of agile, traditional or hybrid project management.

2. Differences of significance **between** project management approaches

Using the hypotheses of research question

A Mann-Whitney U is used to stratify data by agile, traditional and hybrid project management to determine **significance in difference between** the project management approaches

Mann-Whitney U test was used to test each factor against the hypothesis from section 7.5 based on the stratified data to see if there is any significant difference between project management approaches and the respective factor from 1-15. On the next page please see the example for factor "Communication (CO)"

Discusses factor differences between project management approaches using the hypothesis defined in section 7.5
Example: factor Communication (CO)

Hypothesis:
H1a (CO): (T+>A+)

H1b (CO): (H+>A+)

Hypothesis as defined in section 10.5:

Critical Success Factor in Projects	Hypothesis	Direction
1. **Communication** (CO)	H1a (CO): (T+>A+) H1b (CO): (H+>A+)	T+, H+, A+

The analysis of the collected data produced the following results:

Communication (CO)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	115	2,36	0,90	0,38
Hybrid	101	2,45	1,02	0,37
Agile	62	2,60	0,84	0,35
Total	**278**	**2,44**	**0,94**	

As expected, there are differences in how often communication issues are observed between the project management groups. Traditional project management has more communication issues, followed by hybrid project management approaches. This is in line with the expected hypothesis: There are more communication issues using traditional project management approaches compared to agile H1a (CO): (T+>A+): 2,36 vs. 2,60 and also more communication issues in hybrid approaches compared with agile project management H1b (CO): (H+>A+): 2,45 vs. 2,60.

	Communication (CO)	
Mann-Whitney U	3027,500	2646,500
Z	-1,754	-1,673
Asymp. Sig. (2-tailed)	**0,079**	**0,094**
Grouping Variable: PM Group	Significance comparing traditional project management with agile project management	Significance comparing hybrid project management with agile project management

Figure 46: Mann-Whitney U test results for comparing traditional and hybrid with agile project management for factor CO

In the summary table the result can be found here (marked in yellow):

Category	**Critical Success Factor in Projects**	**Support of hypothesis yes / no** Difference between project mgt approach on this factor. (Does the selection of the project mgt approach make a difference?)
	1. **Communication** (CO)	H1a (CO): (T+>A+): no, but some strong numerical indication + (p-value: 0,079) H1b (CO): (H+>A+): no, but some strong numerical indication + (p-value: 0,094)
	2. **Clarity on how to organise**	H2a (OC): (T+>A#): no, but some numerical indication o (p-value: 0,127)

In summary table results can be found here
Example: factor Communication (CO)

The following summarises the findings of research question 3 which are discussed in detail in the following section:

<u>Part 1: Summary of support of factor 1-15:</u>

Table 8.3: Degree of support for the used 15 project management Critical Success Factors (CSF)

Category	Critical Success Factor in Projects	Support of factor[10]	% Supportive (Likert)[11]
Organisational factors (OF)	1. **Communication** (CO)	Yes (strong)	+ 88.8%
	2. **Clarity in how to organise change** (OC)	Yes	o 60.9%
	3. **Risk management** (RM)	Yes	o 56.1%
Team factors (TF)	4. **Accountability** (AC)	Yes	o 66.4%
	5. **Team dynamics/team building** (TD)	Yes (weak)	- 45.8%
	6. **Team skills** (TS)	Yes (weak)	- 49.8%
Customer & stakeholder factors (C&SF)	7. **Stakeholder support and engagement** (SS)	Yes (strong)	+ 83.0%
	8. **Goals or requirements** (GR)	Yes (strong)	+ 82.1%

[10] See Section “Significance of <factor> “ for each factor

[11] On Likert Scale aggregating values of “always”, “often”, “occasionally” (1,2,3).
Indicator of factor strength: + greater 70% agreement, o between 70% and 50 % agreement, - below 50% agreement.

	9. Determining which **solution fits in with the organisation** and its stakeholders (OS)	Yes	o 55.9%
	10. **Clarity in expectation management and deliverables** (EM)	Yes	o 68.9%
	11. **Scope changes** (SC)	Yes (strong)	+ 93.9%
Project uncertainty factors (PUF)	12. **Prioritizing of task and activities** (PT)	Yes	+ 75.1%
	13. **Resource conflicts or deprivations** (RC)	Yes (strong)	+ 85.9%
	14. **Planning and deadlines** (PD)	Yes (strong)	+ 83.6%
	15. **Understanding of complexity and interdependencies** (CI)	Yes (strong)	+ 81.8%

<u>Part 2: Summary of hypothesis testing from research question 3: Is there any significant difference between the Critical Success Factors (CSF) for Traditional, Hybrid and Agile project management approaches?</u>

Table 8.4: Summary of differences between Critical Success Factors (CSF) in Traditional, Hybrid and Agile project management approaches

Category	Critical Success Factor in Projects	**Support of hypothesis yes/no**[12] Difference between project management approaches on this factor. (=selects whether the project management approach make a difference?)
Organisational factors (OF)	1. **Communication** (CO)	H1a (CO): (T+[13]>A+): no, but some strong numerical indication + (p-value: 0.079) H1b (CO): (H+>A+): no, but some strong numerical indication + (p-value: 0.094)
	2. **Clarity in how to organise change** (OC)	H2a (OC): (T+>A#): no, but some numerical indication o (p-value: 0.127) H2b (OC): (H+>A#) no numerical indication - (p-value: 0.875)
	3. **Risk management** (RM)	H3a (RM): (A+>T+): no, and no numerical indication - (p-value: 0.711) H3b (RM): (A+>H+): no, and no numerical indication - (p-value: 0.547)
Team factors (TF)	4. **Accountability** (AC)	H4a (AC): (T+>A+): no, and no numerical indication – (p-value: 0.281) H4b (AC): (H+>A+): no, and no numerical indication - (p-value: 0.661)
	5. **Team dynamics/team building** (TD)	H5a (TD): (T+>A+): no, and no numerical indication - (p-value: 0.45) H5b (TD): (H+>A+): yes, significant at p-value 0.018
	6. **Team skills** (TS)	H6a (TS): (T+>A+): no, but some numerical indication o (p-value: 0.123) H6b (TS): (H+>A+): yes, significant at p-value 0.027

[12] Significant: Yes = p-value below 0,05, strong numerical indication: + p-value between 0,05 and 0,1, neutral: o p-value between 0,1 and 0,20, no evidence p-value > 0,20.
[13] T= Traditional project management, H = Hybrid project management, A = Agile project management
+ = factors have a positive impact on project management performance measured by Project Success Criteria (PSC);
- = factors have a negative impact on project management performance measured by Project Success Criteria (PSC);
= factors have no significant impact on project management performance measured by Project Success Criteria (PSC)
See Section 7.5 for further explanation.

Customer & stakeholder factors (C&SF)	7. Stakeholder support and engagement **(SS)**	H7a (SS): (T+>A+): yes, significant at p-value 0.027 H7b (SS): (H+>A+): yes, significant at p-value 0.023
	8. **Goals or requirements** (GR)	H8a (GR): (T+>A+): no, no numerical indication - (p-value: 0.896) H8b (GR): (H+>A+): no, no numerical indication - (p-value: 0.649)
	9. Determining which **solution fits in with the organisation** and its stakeholders (OS)	H9a (OS): (T+>A+): yes, significant at p-value 0.032 H9b (OS): (H+>A+): no, but some numerical indication + (p-value: 0.091)
	10. **Clarity in expectation management and deliverables** (EM)	H10a (EM): (T+>A+): no, but some numerical indication o (p-value: 0.181) H10b (EM): (H+>A+): no and no numerical indication - (p-value: 0.570)
Project uncertainty factors (PUF)	11. **Scope changes** (SC)	H11a (SC): (T->A-): no, and no numerical indication - (p-value: 0.569) H11b (SC): (H->A-): no, and no numerical indication - (p-value: 0.239)
	12. **Prioritizing of task and activities** (PT)	H12a (PT): (T+>A+): no, but some strong numerical indication + (p-value: 0.056) H12b (PT): (H+>A+): no, but some numerical indication + (p-value: 0.113)
	13. **Resource conflicts or deprivations** (RC)	H13a (RC): (T->A-): yes, significant at p-value 0.009 H13b (RC): (T->A-): yes, significant at p-value 0.000
	14. **Planning and deadlines** (PD)	H14a (PD): (T+>A+): yes, significant at p-value 0.018 H14b (PD): (H+>A+): no, but some numerical indication o (p-value: 0.108)
	15. **Understanding of complexity and interdependencies** (CI)	H15a (CI): (A->T-): no and no numerical indication at all - (p-value: 0.991) H15b (CI): (A->H-): no and no numerical indication at all - (p-value: 0.962)

In the following section, each factor is discussed in detail.

8.1 Communication (CO)

Significance[14] of Communication (CO)

The test of factor significance confirmed that the factor Communication (CO) is highly prevalent in project management. The result shows that this factor is significant with the following result:

Table 8.5: Significance of the factor of Communication (CO)

	t	df	Sig. (2- tailed)	Mean Difference
Communication (CO)	-29.989	276	**0.000**	-1.578

In total the survey data yielded 279 records, from which two items were excluded due to missing or inconsistent data, leaving 277 valid records[15.] As can be seen from Table 8.6, most of the project managers on this survey, 56.3 %, reported that communication issues were either always or quite often an issue in their projects. When the 'occasionally' category is included, the cumulative percentage increases to 89%. This result is very strongly in line with the literature (see Slevin and Pinto (1988), Frey et al. (2009) and Ahimbisibwe (2017), which argues that communication is one of the most critical success factors in project management. Hence more and better communication is beneficial to projects and this increases the likelihood that a project will be successfully completed as measured by the PSC.

[14] Note: In order to determine the significance for each of the 15 factors, the factor mean was set to be equal to or greater than 4, as set out in Table 8.2. See Appendix 4 for more details.
[15] These exclusions were made for statistical significance calculations by the software SPSS. For mean averages these were excluded as well. This holds true for all subsequent factors as well.

Table 8.6: Response distribution of the factor of Communication (CO)

Communication (CO)						
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	37	13.3	13.4	13.4
	2	119	42.7	43.0	56.3
	3	90	32.3	32.5	88.8
	4	29	10.4	10.5	99.3
	5	2	0.7	0.7	100.0
	Total	277	99.3	100.0	
Missing	System	2	0.7		
Total		279	100.0		

Differences of significance for Communication (CO) between project management approaches

Hypotheses as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
1. Communication **(CO)**	H1a (CO): (T+>A+) H1b (CO): (H+>A+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.7: Means by project management approach for the factor Communication (CO)

Communication (CO)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	115	**2.36**	0.90	0.38
Hybrid	100	**2.39**	1.02	0.37
Agile	62	**2.60**	0.84	0.35
Total	**277**			

As expected, there are differences between the project management groups in how often communication issues are observed in each. Traditional project management has more communication issues, followed by hybrid project management approaches. This is as expected in line with the hypothesis that there are more communication issues using traditional project management approaches than using agile – H1a (CO):

(T+>A+): 2.36 vs. 2.60 and also more communication issues in hybrid approaches than in agile project management – H1b (CO): (H+>A+): 2.39 vs. 2.60.

Table 8.8: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of CO

	Communication (CO)	
Mann-Whitney U	3027.500	2646.500
Z	-1.754	-1.673
Asymp. Sig. (2-tailed)	**0.079**	**0.094**
Grouping Variable: PM Group	Significance when traditional project management is compared with agile project management	Significance when hybrid project management is compared with agile project management

With regard to differences between the project management approaches in terms of the communication factor, the significance for the factor communication is not equally clear.

Results for research question 2 suggest that agile project management due to the better integration of communication in the overall project management approach has better outcomes with regard to this factor, which was believed by 45% of the survey participants. This compares to only 6% of survey participants who believe that traditional project management is better with regard to the factor of communication. However, a significant difference between traditional and agile project management could not be established and although the numerical difference is large, it is not significant at the level set of $P = 0.079$ (compared to the $P < 0.05$ threshold defined in this research).

If the differences between hybrid and agile project management are considered the picture is similar. A significant difference in communication issues could not be established between these two project management approaches; the difference was less marked but was similar to the previously reported value for traditional project management as well as not significant at a P-value $P = 0.094$ (compared to the $P < 0.05$ threshold defined in this research). Ahimbisibwe et al. (2014) found that communication is especially important for agile project management and the result that when this factor used and applied in self-organising teams, the number of issues is significantly reduced can be replicated with data from this study, which might explain why a numerical difference exists, albeit not significant.

8.2 Clarity in organising change (OC) a.k.a. Planning and Controlling, monitoring and controlling

Significance of clarity in organising change (OC)
a.k.a. Planning and Controlling, monitoring and controlling

The results of analysing clarity in organising change (OC) were accepted; there are many issues with this topic and these can be observed quite regularly on projects.

Table 8.9: Significance of the factor of Clarity in organising change (OC)

	t	df	Sig. (2- tailed)	Mean Difference
Clarity in organising change (OC)	-15.240	275	**0.000**	-.851

In total the survey data yielded 279 records from which three were excluded due to missing or inconsistent data, leaving 276 valid records. As Table 8.10 shows, almost a third of project managers on this survey, 28.3. %, reported that a lack of clarity in organising change is a regular problem. When we include the ‘occasionally’ category, the cumulative percentage increases to 60.9% which is a strong majority. This result is in line with the literature (see Chapter 3); which showed that clarity in organisational change is important. Another third or 33.7%, however, indicated that clarity in organising change based on derived activities from clear requirements is not essential for successful project work. Therefore, there is some evidence that the more clarity in securing change is, the higher is the project success rate as measured by the PSC. However, it is noted that this factor does not seem to be as critical as other factors in this study.

Table 8.10: Response distribution of the factor of Clarity in organising change (OC)

Clarity in organising change (OC)					
		Frequency	Percent	Valid Percent	Cumulative Percentage
Valid	1	4	1.4	1.4	1.4
	2	74	26.5	26.8	28.3
	3	90	32.3	32.6	60.9
	4	93	33.3	33.7	95.6
	5	15	5.4	5.4	100.0
	Total	276	98.9	100.0	
Missing	System	3	1.1		
Total		279	100.0		

Differences of significance regarding how to organise change (OC) between project management approaches a.k.a. Planning and Controlling, monitoring and controlling

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Clarity in organising change (OC)	H2a (OC): (T+>A#) H2b (OC): (H+>A#)	T+, H +A #

The analysis of the collected data produced the following results:

Table 8.11: Means by project management approach for the factor of Clarity in organising change (OC)

Clarity in organising change (OC)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	114	**3.01**	1.08	0.36
Hybrid	101	**3.25**	0.90	0.28
Agile	61	**3.15**	1.04	0.33
Total	**276**			

As expected, some differences in OC factor issues are observed between the project management groups and are in line with findings of Dvir and Lechler (2004). The data of this research show that traditional approaches raise more issues than agile approaches do. As hypothesised, traditional project management has more OC issues, than hybrid project management approaches do. This is in line with the directional hypothesis: There are more issues regarding “clarity in organising change” for traditional project management approaches than for compared to projects organised in an agile way: H2a (OC): (T+>A#): 3.01 vs. 3.15. Interestingly this does not hold true when comparing OC issues using agile project management approaches than with hybrid approaches to project management: H2b (OC): (H+>A#): 3.25 vs. 3.15., meaning in this case hybrid project management seems to have the least Clarity in organising change (OC) issues. However, what could not be established was the neutral impact on agile project management with regard to this factor (A), as initially assumed (see also section 7.5). Although the mean of 3.15 indicates that issues stemming from a lack of clarity in organising change arise only occasionally, it is significantly different from a mean greater than or equal than 4. Hence it can be concluded that in agile project management also the factor of uncertainty plays some part – although less than in traditional project management (Vinekar et al., 2006). Thus, it may be argued that agile project management does not exhibit the neutrality with regard to project uncertainties and ways to organise the resultant change that was found by Ahimbisibwe et al. (2017). A comparison of project management approaches with regard to differences in mean for the factor OC reveals the following:

Table 8.12: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of OC

	Clarity in organising change (OC)	
Mann-Whitney U	3012,500	3037.500
Z	-1.524	-.157
Asymp. Sig. (2-tailed)	0.127	0.875
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

One can conclude that, with regard to differences between the project management approaches and the factor of "clarity in organising change" (OC), the significance for factor OC is not entirely clear. This conclusion is supported by the answers to research question 2, which asked the survey participants if they believed agile or traditional project management was superior with regard to this factor. The answers suggested that superiority was split between two project management camps (agile 39% vs. traditional 35%) and pointed towards a finding which was ambivalent.

A significant difference between traditional and agile project management could not be established and although the numerical difference is rather large, it is not significant at the level set of $P = 0.127$ (compared to the $P < 0.05$ threshold defined in this research). The result does not replicate the findings of Wysocki, 2019 that agile methods deal with dynamic changes and uncertainty management better than traditional projects, although the numerical indication points in this direction.

When comparing differences between hybrid and agile project management the picture is even less clear. A significant difference in "clarity in organising change" (OC) issues could not be established at all when comparing the value for hybrid to that for agile project management, because the values are clearly not different when P-value = 0.875. This implies that with regard to clarity in organising change issues, hybrid project management seems to be closer to agile project management than to traditional project management. This could be explained by the use of agile tools and techniques in a hybrid approach, which helps to cope with uncertainties on projects.

8.3 Risk Management (RM)

Significance of Risk management (RM)

The analysis of Risk management (RM) shows high significance as well. Hence, the absence of proper risk management has a negative impact on project success and is therefore another important project management factor.

	t	df	Sig. (2- tailed)	Mean Difference
Risk Management (RM)	-12.392	270	**0.000**	-.727

Table 8.13: Significance of the factor of Risk management (RM)

In total the survey data yielded 279 records from which eight were excluded due to missing or inconsistent data, leaving 271 valid records. As can you can see in Table 8.14, a small number of project managers on this survey, 25.1%, reported that risk management issues are either always or quite often an issue in their projects. When we include the ‘occasionally’ category, the cumulative percentage increases to 56.1%. This result is strong but not as clear as some other factors. It is in line with the literature (see Section 7.5), which argues that risk management is a critical project management success factor, although not one of the most critical. Still, it can be concluded that the more risk management is applied in project work the more likely it is that a project will be successfully completed, as measured by the PSC increases. This especially holds true for so-called “fat tail” project risks, which are underestimated risks that have an extremely bad outcome on the PSC if not monitored, i.e. they are rare, extremely adverse results which are not sufficiently considered if project risk management is deficient. One famous example is the mistake made in the Mars Climate Orbiter project, where two different measurement systems were used, with the result that commands from earth were sent in imperial units without being converted into the metric standard (NASA, 2018). This was known to be a risk, but no action was taken because the knowledge was shared at a lower non-executive level only.

Table 8.14: Response distribution of the factor Risk management (RM)

Risk Management (RM)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	8	2,9	3.0	3.0
	2	52	18.6	19.2	22,1
	3	92	33.0	33.9	56.1
	4	96	35.4	35.4	91.5
	5	23	8.2	8.5	100.0
	Total	271	97.1	100.0	
Missing	System	8	2.9		
Total			279	100.0	

Differences of significance for Risk management (RM) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	Hypothesis	Direction
Risk Management (RM)	H3a (RM): (A+>T+) H3b (RM): (A+>H+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.15: Means by project management approach for the factor of Risk management (RM)

Risk Management (RM)	Number	Mean	SD	Coefficient of Variation (CoV)
Traditional	114	**3.26**	1.06	0.32
Hybrid	98	**3.23**	1.28	0.39
Agile	59	**3.27**	1.34	0.41
Total	278			

As anticipated, there are differences between project management groups in the frequency with which risk management (RM) issues are observed. However, compared to the agile project approach hybrid project management had unexpectedly slightly more risk management issues, followed by traditional project management approaches. This is in line with the directional hypothesis H3a (RM): (A+>T+): 3.27 vs. 3.26 and also different from the slightly greater number of issues found in hybrid approaches compared with agile project management H3b (RM): (A+>H+): 3.27 vs. 3.23. However, these results are so close so that no clear difference between the factor RM can be reported.

Originally the hypothesis was driven by the fact that agile standards make only general statements about risk management. For instance, the Scrum Guide (Schwaber and Sutherland, 2011 and 2017) does not provide concrete guidance on risk management. Hence, it may be presumed that the agile community developed procedures based on practical experience which were then generally applied on agile projects, leading to better results for the risk factor.

For instance, the agile principle to “fail fast” in the area of product development ensures that decisions are made rigorously to continue with a piece of work or to try a different approach if early evidence of success is not forthcoming. In addition, interviews in the present research revealed that in agile practice entries are often prioritized according to the level of risk in the backlog. Such entries are then handled as soon as possible, which consequently reduces project risk. Therefore, no evidence can be established for the previous hypothesised argument that the lack of formality causes less risk management in agile project management. This is in line with research question 2, which revealed that a majority of almost 55% see neither agile nor traditional project management to be better suited in the area of risk management, although 30% believed traditional project management was superior in this aspect compared to 16% who believed the same of agile project management.

Table 8.16: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for factor of RM

	Risk Management (RM)	
Mann-Whitney U	3253.000	2732.500
Z	-.370	-.602
Asymp. Sig. (2-tailed)	0.711	0.547
Grouping Variable: PM Group	Significance if traditional project management is compared with agile project management	Significance if hybrid project management is compared with agile project management

Hence it is not surprising that when it comes to differences between the project management approaches and the risk factor, the significance for the factor of risk could not be established either, and therefore no significant difference between traditional and agile project management could be found. There seems to have been a somewhat numerical difference, but it was not significant at all at the level set of $P = 0.711$.

The picture is similar when the differences between hybrid and agile project management are compared. A significant difference in risk issues could not be established between these two project management approaches, which was less strong but similar to the previously reported value for traditional project management and also not significant at a P-value of $P = 0.547$ (compared to the $P < 0.05$ threshold defined in this research).

Therefore, no evidence was found for the previous hypothesis that there is less risk management in agile projects due to the lack of formality. Hence a lower risk management performance for agile project management by the level of reported challenges based on improper risk management/contingency plans (Walczak and Kuchta, 2013) could not be replicated. Rather, slightly more risk management issues were found in hybrid and traditional organised projects. This somewhat contradicts the subjective findings of research question 2 where 55% of the survey participants believed that traditional project management was superior. This can be explained in terms of the risk type, which might be quite different for traditional and agile project management approaches (delivery of specification vs. customer satisfaction; see Section 2.3.13) and also for different types of project. For instance, to ensure traceability a medical or aviation project is seldom managed in an agile way, although the trend is towards using hybrid approaches (Vanderleest and Butler, 2009).

8.4 Accountability (AC) a.k.a. team commitment

Significance of Accountability (AC)

With regard to significance, the factor of Accountability (AC) is a significant factor as shown in Table 8.17 and hence another well identified success factor in project management.

Table 8.17: Significance of the factor of Accountability (AC)

	t	df	Sig. (2- tailed)	Mean Difference
Accountability (AC)	-16.917	273	**.000**	-.938

In total the survey data yielded 279 records, of which five were excluded due to missing or inconsistent data, resulting in 274 valid records. As Table 8.18 shows, some project managers on this survey, 32%, reported that accountability issues are either always or quite often an issue on their projects. When the ‘occasionally’ category is included, the cumulative percentage increases to 66.4%.

At the same time, almost 30% also reported that accountability issues are not very often observed. Interestingly, when project management groups are compared, occasional accountability issues seem to be a bigger problem for agile project managers. Originally the opposite was hypothesised, because the agile project management framework stems from the notion of self-organising teams.

The more responsibilities and accountable team members are on projects, the better it is for project work, but agile project management seems to have *more infrequent accountability* issues than hybrid and traditional project management have (see Table 8.19: Breakdown of the factor Accountability (AC)). One reason could be a non-fitting team composition, which is not frequent but occurs from time to time. It could have a specifically bad impact on this factor in the agile project management framework, as Hoegl and Gemünden (2001) describe. Another explanation can be seen in the importance of team work (see Moe et al. 2010 and Ahimbisibwe, 2017), the absence of which in Agile projects is a relatively severe problem.

Table 8.18: Response distribution of the factor of Accountability (AC)

Accountability (AC)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	12	5.3	5.4	5.4
	2	61	21.9	22.3	26.6
	3	109	39.1	39.8	66.4
	4	82	29.4	29.9	96.4
	5	10	3.6	3.6	100.0
	Total	274	98.2	100.0	
Missing	System	5	1.8		
Total		279			

Table 8.19: Breakdown of the factor of Accountability (AC)

Accountability (AC)					
	1	2	3	4	5
Traditional	7%	23%	37%	29%	3%
Hybrid	3%	24%	36%	33%	2%
Agile	2%	18%	48%	26%	6%

Differences of significance of Accountability (AC) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Accountability (AC)	H4a (AC): (T+>A+) H4b (AC): (H+>A+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.20: Mean by project management approach for the factor of Accountability (AC)

Accountability (AC)	Number	Mean	SD	Coefficient of Variation (CoV)
Traditional	114	**2.98**	1.08	0.36
Hybrid	98	**3.08**	1.21	0.39
Agile	62	**3.18**	0.86	0.27
Total	274			

There are differences in how often Accountability (AC) issues are observed between the project management groups. Traditional project management suffers more accountability issues, followed by hybrid project management approaches. As mentioned previously, this is in line to the expected hypothesis, which stated that agile project management should have fewer accountability issues. Although more accountability issues are found with traditional project management approaches than with agile ones, H4a (AC): (T+>A+): 2.98 vs. 3.18, for hybrid project management, the means are very similar. H4b (AC): (H+>A+): 3.08 vs. 3.18 and hence hypothesis H+>A+ does hold.

Table 8.21: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of AC

	Accountability (AC)	
Mann-Whitney U	3203.500	2920.000
Z	-1.079	-.439
Asymp. Sig. (2-tailed)	0.281	0.661
Grouping Variable: PM Group	Significance when traditional project management is comparing with agile project management	Significance when hybrid project management is compared with agile project management

With regard to differences between the project management approaches and the Accountability (AC) factor, the significance for the factor of accountability is not clear. A significant difference between traditional and agile project management could not be established and although the numerical difference is somewhat sizable, it is not significant at the level set of $P = 0.281$ (compared to the $P < 0.05$ threshold defined in this research).

When comparing differences between hybrid and agile project management the picture is even more doubtful. A significant difference in accountability issues could not be established between these two project management approaches. This was even less strong and not significant at a P-value of $P = 0.661$ either (compared to the $P < 0.05$ threshold defined in this research). Both findings are in line with Ahimbisibwe et. al. (2017), which could not also find significant differences between agile and traditional project management.

8.5 Team dynamics/team building (TD)

Significance of Team dynamics/team building (TD)

With regard to Team dynamics/team building (TD) it can be concluded that this factor is less distinct than previously discussed factors in terms of t and mean difference; however, it is still significant. Hence, team issues have a negative impact on the project success as measured by the Project Success Criteria (PSC).

Table 8.22: Significance of the factor of Team dynamics/team building (TD)

	t	df	Sig. (2- tailed)	Mean Difference
Team dynamics/team building (TD)	-9.176	274	**0.000**	-.585

In total the survey data yielded 279 records of which four were excluded due to missing or inconsistent data, so 275 valid records remained. As can be seen in Table 8.23, a rather small number of project managers on this survey, 26.8 %, reported that team dynamic issues are either always or quite often an issue in their projects. When we include the ‘occasionally’ category, the cumulative percentage increases to 45.8%. This result is rather weak. The literature emphasises the need for successful teams (see Shokri-Ghasabeh and Kavousi-Chabok (2009), Mir and Pinnington (2013), and Jun et. al (2011) which argues that team dynamics is rather critical for project success. This finding supports the view that positive team dynamics are benefit projects and this also supports the likelihood that a project will be successfully completed as measured by the PSC, and that negative team dynamics have an impact on the ability of a project to succeed, as well. One explanation could be that once a team has gone through the regular team building phases of forming, storming, norming, and performing (Tuckmann, 1964), this factor is less critical than other project management factors. Hence, this factor might be subject to the maturity of team building, which is perhaps another factor worth considering in analyses of team project issues to do with Team dynamics/team building.

Table 8.23: Response distribution of the factor of Team dynamics/team building (TD)

Team dynamics/team building (TD)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	13	5.7	5.7	5.7
	2	45	16.1	16.4	21.1
	3	68	25.4	25.7	45.8
	4	113	40.5	41.1	86.9
	5	36	12,9	13.1	100.0
	Total	275	98.6	100.0	
Missing	System	4	1.4		
Total			279	100.0	

Differences of significance of Team dynamics/team building (TD) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Team dynamics/team building (TD)	H5a (TD): (T+>A+) H5b (TD): (H+>A+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.24: Mean by project management approach for the factor of Team dynamics/team building (TD)

Team dynamics/team building (TD)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	115	**3.49**	1.04	0.30
Hybrid	100	**3.21**	1.20	0.37
Agile	60	**3.62**	1.24	0.34
Total	**275**			

As expected, there are differences in how often team dynamics/team building (TD) issues are observed in different project management groups. Hybrid project management has more team dynamics/team building (TD) issues, followed by traditional project management approaches. This is in line with the hypothesis and the literature (Mir and Pinnington (2013), Jun et. al (2011) and Xu et al (2010)). There are more team dynamics/team building issues using traditional project management approaches than using agile H5a (TD): (T+>A+): 3.49 vs. 3.62 and also many more Team dynamics/team building issues in hybrid approaches than in agile project management H5b (TD): (H+>A+): 3.21 vs. 3.62.

Table 8.25: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of TD

	Team dynamics/team building (TD)	
Mann-Whitney U	3223.500	2357.000
Z	-.756	-2.368
Asymp. Sig. (2-tailed)	0.450	0.018
Grouping Variable: PM Group	Significance when traditional project management is compared with agile project management	Significance when hybrid project management is compared with agile project management

With regard to differences between the project management approaches in terms of dynamics/team building (TD) factor, the significance for this factor is not as clear. A significant difference between traditional and agile project management could not be established and although the numerical difference could be observed, this is not significant at the level set of $P = 0.450$ (compared to the $P < 0.05$ threshold defined in this research).

When comparing differences between hybrid and agile project management the picture is different. *A significant difference in team dynamics/team building (TD) issues could be established between these two project management approaches*, a strong finding compared to the previously reported value for traditional project management at a *P*-value of $P = 0.018$ (compared to the $P < 0.05$ threshold defined in this research).

The reason for this might be the non-rigorous use of various project management philosophies, which makes it more difficult to establish a common approach and philosophy with consensus on running a project.

8.6 Team skills (TS)

Significance of Team skills (TS)

The factor of Team skills (TS) is significant, as the following tables show, although less than the previous ones that use the mean difference as indicator.

Table 8.26: Significance of the factor of Team skills (TS)

	t	df	Sig. (2- tailed)	Mean Difference
Team skills (TS)	-11.836	270	**0.000**	-,601

In total the survey data yielded 279 records of which eight had to be excluded due to missing or inconsistent data, leaving 271 valid records. As set out in Table 8.27, only a rather small number of project managers on this survey, 15.2 %, reported that team skill issues are either always or quite often an issue in their projects. When all the supporting Likert scale categories for this factor are taken into consideration, the cumulative percentage increases to 49.8%. This result suggests that team skills are not major factors but nevertheless can sometimes be quite decisive for project success. Thus, to have the right team skills available can be an important critical success factor for ensuring that a project can be successfully completed as measured by the PSC. However, from the evidence of this research this factor is not found as important as other writers have found it, such as Arumugam et al. (2013), Handzic et al. (2013) and Mir and Pinnington (2013).

Table 8.27: Response distribution of the factor of Team skills (TS)

Team skills (TS)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	8	2,9	3.0	3.0
	2	25	9.0	9.2	12,2
	3	102	36.6	37.6	49.8
	4	123	45.1	45.4	95.2
	5	13	5.7	5.8	100.0
	Total	271	97.1	100.0	
Missing	System	8	2.9		
Total			279	100.0	

Differences in the significance of Team skills (TS) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Team skills (TS)	H6a (TS): (T+>A+) H6b (TS): (H+>A+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.28: Mean by project management approach for the factor of Team skills (TS)

Team skills (TS)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	114	**3.39**	0.93	0.27
Hybrid	97	**3.27**	1.29	0.39
Agile	60	**3.63**	1.01	0.24
Total	**271**			

Reviewing the means of team skills reveals differences between the project management approaches. Already in research question 2, the result was that 42% of project managers believed that agile project management is better with regard to team skills since this is an approach embedded in agile project management. Hybrid project management has more Team skills issues, followed closely by traditional project management. This is in line with the hypothesis: There are more team skills issues using traditional project management approaches than using agile – H-6a (TS):

(T+>A+): 3.39 vs. 3.63 and also more team skills issues in hybrid approaches than in agile project management H6b (TS): (H+>A+): 3.27 vs. 3.63.

Table 8.29: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of TS

	Team skills (TS)	
Mann-Whitney U	2975.000	2343.500
Z	-1.544	-2,207
Asymp. Sig. (2-tailed)	0.123	0.027
Grouping Variable: PM Group	Significance if traditional project management is compared with agile project management	Significance if hybrid project management is compared with agile project management

With regard to differences between the project management approaches in terms of the team skills (TS) factor, the significance for this factor is not very clear. A significant difference between traditional and agile project management could not be established and although the numerical difference is large, it is not significant at the level set at $P = 0.123$ (compared with the $P < 0.05$ threshold defined in this research).

To comparing differences between hybrid and agile project management yields a different picture. A significant difference in team skills issues can be established between these two project management approaches, which contradicts the reported value for traditional project management significant at a P-value of $P = 0.027$ (compared to the $P < 0.05$ threshold defined in this research).

This can be explained by the rather large variation in the hybrid mean data. As hybrid approaches mix many varied tool and project management techniques, the variation of results is also wide. Both findings (hybrid, significant and traditional low p-value but not significant) lead to the strong likelihood of a difference in team skills between hybrid and traditional, on the one hand, and agile project management, on the other, as outlined also in the literature in general for project management by Aguanno (2005), Alexandrova and Ivanova (2013), Ahimbisibwe et al. (2015), Mir and Pinnington (2013), Shokri-Ghasabeh and Kavousi-Chabok (2009)).

8.7 Stakeholder support and engagement (SS) a.k.a. Top management support

Significance of stakeholder support and engagement (SS) a.k.a. top management support

The analysis of significance of stakeholder support and engagement (SS) has been reported in many research articles (e.g. Aguanno (2005), Alexandrova and Ivanova (2013), McManus, (2005)). Hence it is one of the most important factors (see Shokri-Ghasabeh and Kavousi-Chabok, (2009) and can easily have a negative impact on project success as measured by the Project Success Criteria (PSC). With the data of this research, this aspect can be summarised as in Table 8.30.

Table 8.30: Significance of the factor of Stakeholder support and engagement (SS)

	t	df	Sig. (2- tailed)	Mean Difference
Stakeholder support and engagement (SS)	-25.314	276	0.000	-1.260

In total the survey data yielded 279 records of which two were excluded due to missing or inconsistent data, resulting in 277 valid records. As Table 8.31 shows, the largest group of project managers in this survey, 45.1 % of the total, reported that these issues are either always or quite often encountered in their projects. When the 'occasionally' category is included, the cumulative percentage increases to 83%. This result is very strongly in line with the literature (see Section 7.5), which argues that stakeholder support and engagement form one of the most critical in project management. Hence more stakeholder support and engagement are beneficial to projects, supporting the likelihood that a project will be successfully completed as measured by the PSC.

Table 8.31: Response distribution of the factor of Stakeholder support and engagement (SS)

Stakeholder support and engagement (SS)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	17	6.1	6.1	6.1
	2	91	32.6	32,9	39.0
	3	122	43.7	45.0	83.0
	4	41	15.7	15.8	97.8
	5	6	2.2	2.2	100.0
	Total	277	99.3	100.0	
Missing	System	2	0.7		
Total			279	100.0	

Differences of significance of Stakeholder support and engagement (SS) between project management approaches

Critical Success Factor in Projects	Hypothesis	Direction
Stakeholder support and engagement (SS)	H7a (SS): (T+>A+) H7b (SS): (H+>A+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.32: Mean by project management approach for the factor of Stakeholder support and engagement (SS)

Stakeholder support and engagement (SS)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	115	**2.67**	0.88	0.33
Hybrid	100	**2.67**	1.01	0.38
Agile	62	**2.98**	0.80	0.27
Total	277			

As expected, there are differences in how often different stakeholder support and engagement (SS) issues are observed in the project management groups. Traditional project management has more stakeholder SS issues, together with hybrid project management approaches, with a similar result. This is in line with the hypothesis: There are more stakeholder issues with traditional project management approaches than with agile approaches H7a (SS): (T+>A+): 2,67 vs. 2,98 and also more communication issues in hybrid approaches in agile project management H7b (SS): (H+>A+): 2,72 vs. 2,98.

Table 8.33: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of SS

	Stakeholder support and engagement (SS)	
Mann-Whitney U	2891.000	2486.000
Z	-2.217	-2.281
Asymp. Sig. (2-tailed)	0.027	0.023
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to differences between the project management approaches and the Stakeholder support and engagement factor, the significance for the factor of Stakeholder support is clear. A significant difference between traditional and agile project management could be established at the level set of $P = 0.027$ (compared to the $P < 0.05$ threshold defined in this research).

When comparing differences between hybrid and agile project management the picture is similar. A significant difference in stakeholder issues could be established between these two project management approaches, which was less strong but similar to the previously reported value for traditional project management as well as significant at a P-value of $P = 0.023$ (compared to the $P < 0.05$ threshold defined in this research).

This is an interesting finding in that it confirms the integrative stakeholder support and engagement of the agile methodology (e.g. via the product owner, the short feedback cycle with stakeholders and the involvement of stakeholders in the product development cycle) and the previous findings of Moe et. al. (2010) and Rubin, (2012) on stakeholder involvement. However. hybrid project management does not seem significantly different in this respect from traditional project management. For this factor, hybrid project management seems to be closer to traditional project management than to agile project management, which is also supported by the Helena (2017) study. This is not surprising since most hybrid approaches use the traditional project management approach enriched by agile practices (see also the results of research question 1, survey question 5: Which project management frameworks, methods, tools or process models do you combine?), which indicates that hybrid approaches are created around the traditional project management model in 53% of all cases of hybrid project management.

8.8 Goals or requirements (GR) a.k.a. project objectives, project mission

Significance of Goals or requirements (GR) a.k.a. project objectives, project mission

With regard to Goals or requirements (GR) it could be concluded that this factor is one of the most critical in terms of significance. Hence, issues with Goals or requirements quickly result in outcomes with a negative impact on the project success, as has been measured. This result is very strongly in line with the literature (see Ika et al. (2012), Serra and Kunc (2014) and Taherdoost and Keshavarzsaleh (2016) , which argues that clear goals/requirements form one of the most critical project management success factors.

Table 8.34: Significance of the factor of goals or requirements (GR)

	t	df	Sig. (2- tailed)	Mean Difference
Goals or requirements (GR)	-25.964	272	0.000	-1.370

In total the survey data yielded 279 records, of which six were excluded due to missing or inconsistent data, resulting in 273 valid records. As can be seen in Table 8.35, a good number, 46.3 %, of project managers in this survey reported that goals or requirements are either always or quite often an issue in their projects. When all the supportive Likert Scale elements are included, the cumulative percentage increases to 82,1%. Hence the better the goals are defined, the better project success is ensured as measured by the PSC. What is now interesting is to see if there are any differences between project approaches, given that agile project management was mainly devised to tackle issues with changing project goals and requirements.

Table 8.35: Response distribution of the factor of goals or requirements

Goals or requirements (GR)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	25	9.0	9.2	9.2
	2	103	36.9	37.7	46.9
	3	96	35.4	35.2	82.1
	4	46	16.5	16.8	98.9
	5	3	1.1	1.1	100.0
	Total	273	97.8	100.0	
Missing	System	6	2.2		
Total			279	100.0	

Differences of significance of Goals or requirements between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Goals or requirements (GR)	H8a (GR): (T+>A+) H8b (GR): (H+>A+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.36: Mean by project management approach for the factor of Goals or requirements (GR)

Goals or requirements (GR)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	114	2,60	1.00	0.38
Hybrid	98	2.67	1.29	0.48
Agile	61	2.62	1.16	0.44
Total	278			

As expected, the project management groups differ in how often goals or requirements issues can be observed in them, although the differences are less than expected. Traditional project management has more goal and requirement issues than agile project management, which is in line with the hypothesis and the literature (Taherdoost and Keshavarzsaleh (2016), Ika et al. (2012), Serra and Kunc (2014)). It is surprising to see that the participants reported the least number of problems with regard to hybrid project management. This however is only slightly in line with the hypothesis that there are more goal and requirement issues using traditional project management approaches than using agile H8a (GR): (T+>A+): 2.60 vs. 2.62, but slightly more goal and requirement issues when hybrid approaches are compared to agile project management H8b (GR): (H+>A+): 2.67 vs. 2.62. It should be added, however, that the values are rather close between the groups and therefore group comparisons should be discussed in more detail.

Table 8.37: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of GR

	Goals or requirements (GR)	
Mann-Whitney U	3437.500	2866.500
Z	-.131	-.455
Asymp. Sig. (2-tailed)	0.896	0.649
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to differences between the project management approaches and the goal and requirement factor, the significance for the factor of goals and requirements cannot be established. A significant difference between traditional and agile project management could not be established because small numerical differences have already suggested. It is very clearly not significant at the level set of $P = 0.896$ (compared to the threshold of $P < 0.05$ defined in this research).

The picture is similar in comparisons of the differences between hybrid and agile project management. A significant difference in goal and requirement issues could not be established between these two project management approaches; it was less strong but similar to the previously reported value for traditional project management and also clearly not significant at a P-value of $P = 0.649$ (compared to the $P < 0.05$ threshold defined in this research). The conclusion is that with regard to goals and requirements, these issues are similarly prevalent for all project management approaches. This is somewhat surprising, as other studies have found a difference between traditional and agile project management (see Chapter 2.3 and specifically Munassar and Govardhan, 2010 and Wysocki, 2019. which concluded differences between agile and traditional project management). Also, the result for research question 2. when we asked project managers what is more suited, traditional or agile project management, with regard to goal and requirement, 64% believed agile project management is superior. Looking to the factor from a significance perspective however, this clear differentiation could not be established in this research. One reason might be the fact that agile findings were largely based on software engineering projects, which are *not* representative of all types of project.

8.9 Determining which solution fits in with the organisation and its stakeholders (OS)

Significance of determining which solution fits in with the organisation and its stakeholders (OS)

The fit of factor to solution (OS) is significant, meaning that there may be serious issues in applying a given solution to a problem, although the numerical evidence is not very strong. Nevertheless, it can be established that the use of unfit project solutions has a negative impact on project success as measured by the Project Success Criteria (PSC).

Table 8.38: Significance of the factor determining which solution fits in with the organisation and its stakeholders (OS)

Determining which solution fits in with the organisation and its stakeholders (OS)	t	df	Sig. (2- tailed)	Mean Difference
	-11.936	263	**0,000**	-.708

In total the survey data gave 279 responses of which 15 were excluded due to missing or inconsistent data, resulting in 264 valid records. As listed in Table 8.39, only a few of the project managers who took part in this survey, 24.2 %, reported that solution fits are prevalent issues in projects. When all the supporting responses are taken into account, the cumulative percentage increases to 55.9%. Although not the majority, a good proportion or 36.7% gave feedback that this is not a major issue in projects.

Interestingly, this factor was also one of the items where the survey participants did not provide any feedback at all. Hence it can be concluded that there may be some uncertainty on this factor. Thus, solution fit issues seem to be a rather weak critical success factor for projects. Nevertheless, a better fit can still be seen to benefit projects, which is a similar finding to that of Ahimbisibwe et al. (2017).

Table 8.39: Response distribution of the factor of Determining which solution fits in with the organisation and its stakeholders (OS)

Determining which solution fits in with the organisation and its stakeholders (OS)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	9	3.2	3.4	3.4
	2	46	16.5	17.4	20,8
	3	90	32.3	35.1	55.9
	4	97	35.8	36.7	91.7
	5	22	7.9	8.3	100.0
	Total	264	95.6	100.0	
Missing	System	15	5.4		
Total			279	100.0	

Differences of the significance of determining between project management approaches which solution fits in with the organisation and its stakeholders (OS)

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	Hypothesis	Direction
Determining which solution fits in with the organisation and its stakeholders (OS)	H9a (OS): (T+>A+) H9b (OS): (H+>A+)	T+, H+, A +

The analysis of the collected data produced the following results:

Table 8.40: Mean by project management approach for the factor of Determining which solution fits in with the organisation and its stakeholders (OS)

Determining which solution fits in with the organisation and its stakeholders (OS)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	109	**3.20**	1.43	0,45
Hybrid	97	**3.26**	1.32	0,39
Agile	58	**3.52**	1.42	0.40
Total	264			

As expected, differences are observed in how often determining which solution fits in with the organisation and its stakeholders (OS) occurs in the project management groups. Not surprisingly, traditional project management has more solution fit issues, followed by hybrid project management approaches with the same mean but a lower standard deviation. This is in line with the hypothesis: There are more solution fit issues with traditional project management approaches than with agile H9a (OS): (T+>A+): 3.20 vs. 3.52 and this also holds true for hybrid approaches compared with agile project management H9b (OS): (H+>A+): 3.26 vs. 3.52.

Table 8.41: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of which solution fits in with the organisation and its stakeholders (OS)

	Determining which solution fits in with the organisation and its stakeholders (OS)	
Mann-Whitney U	2550.500	2383.000
Z	-2.150	-1.688
Asymp. Sig. (2-tailed)	0.032	0.091
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to differences between the project management approaches and the solution factor, the significance for the factor solution fit is clear for traditional project management but not for hybrid project management. A significant difference between traditional and agile project management could be established as significant at the level set of $P = 0.032$ (compared to the $P < 0.05$ threshold defined in this research).

When comparing differences between hybrid and agile project management the picture is similar but not clear with regard to significance. A significant difference in solution fit issues could not be established between these two project management approaches for traditional project management because a significant value at a P-value of $P = 0{,}091$ (compared to the $P < 0.05$ threshold defined in this research) could not be established. Since the mean difference is similar, the lower variation in the hybrid data made it not significant as compared to the traditional project management group. In general, however the research result suggests that agile project management seems to be better suited to situations where a better solution fit can be achieved since this factor has fewer reported issues for this project management approach. This confirms the findings of Jun et al. (2011) who also showed that the early conflicts – more often an issue in traditional organised projects – resulting from the larger stakeholder involvement in agile project management, positively affected the project success with this approach. With this, the findings of Ahimbisibwe et al. (2017) could also be replicated. The finding that hybrid project management does not return a significant result can probably be inferred from the fact that hybrid project management uses agile tools as well; hence there are no entirely clear differences between hybrid project and agile projects with regard to this factor, although some strong numeric indications.

8.10 Clarity in expectation management and deliverables (EM)

Significance of Clarity in expectation management and deliverables (EM)

The analysis of Clarity in expectation management and deliverables (EM) is a significant factor, as shown in Table 8.42. Müller and Jugdev (2012) as well as Ahimbisibwe et al. (2015) concluded that user participation in project work makes a positive contribution to project success. The data of the present study can also confirm this aspect of project management with the significance of this factor in project management.

Table 8.42: Significance of the factor of Clarity in expectation management and deliverables (EM)

	t	df	Sig. (2- tailed)	Mean Difference
Clarity in expectation management and deliverables (EM)	-17.869	272	**0.000**	-1.007

In total the survey data produced 279 records of which six were excluded due to missing or inconsistent data, resulting in 273 usable records. As shown in Table 8.43, a good number of project managers on this survey, 36.2%, reported that expectation issues are either always or quite often an issue in their projects. When all the supportive data points are taken into consideration, the cumulative percentage increases to 68.9%. This result is in line with the literature (see Section 7.5 and Rubin, 2012, Müller and

Jugdev (2012), Ahimbisibwe et al. (2015) and Handzic et al. 2013) which argues that clarity over what is expected from a project team is an important prerequisite for successful project management. Hence more clarity about the deliverables is helpful during the execution of projects and this helps to successfully conclude project work, as measured by the PSC.

Table 8.43: Response distribution of the factor of Clarity in expectation management and deliverables (EM)

Clarity in expectation management and deliverables (EM)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	8	2.9	2.9	2.9
	2	83	29,7	30,4	33.3
	3	97	35.8	35.5	68.9
	4	73	26.2	26.7	95.6
	5	12	5.3	5.4	100.0
	Total	273	97.8	100.0	
Missing	System	6	2.2		
Total			279	100.0	

Differences of significance of Clarity in expectation management and deliverables (EM) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Clarity in expectation management and deliverables (EM)	H10a (EM): (T+>A+) H10b (EM): (H+>A+)	T+, H+, A+

The analysis of the collected data produced the following results:

Table 8.44: Mean by project management approach for the factor of Clarity in expectation management and deliverables (EM)

Clarity in expectation management and deliverables (EM)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	114	**2.84**	1.08	0.38
Hybrid	99	**3.13**	0.90	0.28
Agile	60	**3.05**	1.04	0.34
Total	273			

Comparing the different project management groups reveals differences between them. Traditional project management has the highest number of expectation management and delivery issues. As highlighted in section 3.3 and highlighted in detail by Wysocki, 2019, planning as a traditional project management method with unclear goals remains difficult, since traditional methods work with fixed milestones and key figures, and when requirements are unclear, they cannot be planned so precisely.

Hybrid approaches seem to work much better for this factor and are closer to agile project management in this respect. This is in line with the expected hypothesis: There are more expectation management issues with traditional project management approaches than with agile H10a (EM): (T+>A+): 2.84 vs. 3.05. Plainly, hybrid approaches compared with agile project management H10b (EM) are even superior for this specific factor: (H+>A+): 3.13 vs. 3.05, although the numeric difference is not large.

Table 8.45: Mann-Whitney U test results from comparing traditional and hybrid with agile project management for the factor of clarity in expectation management and deliverables (EM)

	Clarity in expectation management and deliverables (EM)	
Mann-Whitney U	3017.000	2818.000
Z	-1.338	-.568
Asymp. Sig. (2-tailed)	0.181	0.570
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to differences between the project management approaches and the factor of clarity in expectation management and deliverables, the significance for this factor is not so clear, although in research question 2 when project managers were asked whether traditional or agile project management was more suited, 49% believed that agile project management was superior to traditional project management.

However, when analysed statistically, a significant difference between traditional and agile project management could not be established and although the numerical difference is observable, it is not significant at the level set of $P = 0.181$ (compared to the $P < 0.05$ threshold defined in this research).

Comparing differences between hybrid and agile project management produces a less clear picture. A significant difference for the factor of clarity in expectation management and deliverables could not be established at all and the numerical difference was rather small. Hence the difference between hybrid and agile project management was weak at a *P*-value of $P = 0.57$ (compared to the $P < 0.05$ threshold defined in this research). This implies that for this factor, hybrid project management is actually rather closer to agile project management. The Helena study (Helena, 2017), showed that planning and configuration management for hybrid project management is used in a more traditional way, while the activities around the requirements of engineering, implementation, integration, and testing tend to be observed with agile project management approaches could explain the P's differences i.e. the adjustment to the situation of hybrid project management explains why there is a large difference when comparing traditional with hybrid project management but is rather small when compared to agile project management.

8.11 Scope changes (SC) a.k.a. specification changes

Significance of Scope changes (SC)

The analysis of scope changes (SC) revealed that this is a significant factor with a large t (276) =-38.954 and mean difference of -1.903. Hence it is one of the most important factors in this study. When scope changes occur in an uncontrolled and unmanaged way, they negatively influence the project success, as measured by the Project Success Criteria (PSC).

Table 8.46: Significance of the factor of scope changes (SC)

	t	df	Sig. (2- tailed)	Mean Difference
Scope changes (SC)	-38.954	276	**0.000**	-1.903

During this study 279 responses were recorded of which two were excluded due to missing or inconsistent data, resulting in 277 usable records. In Table 8.47 it appears that a very clear majority of project managers on this survey, 75.0 %, reported that scope change issues are either always or quite often an issue in their projects. When we include the 'occasionally' category, the cumulative percentage increases to 93.9%. This result is unquestionably in line with the literature (see Section 7.5) which argues that the adequate management of scope changes is one of the most critical factors in successful project management (see Anbari, 2003. Munassar and Govardhan, 2010, Schopka, 2015, Conforto et al., 2016 and Dvir and Lechler (2004). Hence fewer scope changes (-) or adequate management of them (see also section 3.2.4) would benefit projects and this clearly makes a huge difference to the frequency of project success as measured by the PSC.

Table 8.47: Response distribution of the factor of scope changes (SC)

Scope changes (SC)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	62	22.2	22.4	22.4
	2	143	51.3	51.6	75.0
	3	55	19.7	19.9	93.9
	4	17	6.1	6.1	100.0
	5	2	0.7	100.0	
	Total	277	99.3		
Missing	System	279	100.0		
Total					

Differences of significance of Scope changes (SC) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Scope changes (SC)	H11a (SC): (T->A-) H11b (SC): (H->A-)	T-, H-, A-

The analysis of the collected data produced the following results:

Table 8.48: Mean by project management approach for the factor of Scope changes (SC)

Scope changes (SC)	Number	Mean	SD	Coefficient of Variation (CoV)
Traditional	115	**2.08**	0,80	0,38
Hybrid	101	**2.18**	0.88	0.40
Agile	61	**2.00**	0.73	0.37
Total	277			

Unlike the original expectation, only small differences can be observed in how often scope change issues arise in the project management groups. It is clear that agile project management, traditional and hybrid project management have similar reported challenges, in absolute terms, from scope changes. Hence the data are not in line with the hypothesis that there are more scope challenges in traditional and hybrid project management than in agile project management. It could not be established that more scope changes issues arise with traditional project management approaches than with agile ones H11a (SC): (T->A-): 2.08 vs. 2.00 or more scope changes issues in hybrid approaches than with agile ones H11b (SC): (H->A-): 2.18 vs. 2.00. This is surprising, because the results of research question 2 suggested the opposite. When project managers were asked if agile project management was superior to traditional project management almost half believed that it was. When the number of issues with regard to this factor were compared, no significant differences were found, as the following table shows:

Table 8.49: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of SC

	Scope changes (SC)	
Mann-Whitney U	3341.000	2767.000
Z	-.570	-1.178
Asymp. Sig. (2-tailed)	0.569	0.239
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to differences between the project management approaches in relation to scope changes, the significance for this factor is not clear. A significant difference between traditional and agile project management could not be established with large numerical differences. It is not significant at the level set of $P = 0.569$ (compared to the $P < 0.05$ threshold defined in this research). This is in line with Ahimbisibwe et al. (2017) p. 418, who also could not confirm this relationship between traditional and agile project management.

In comparisons of differences between hybrid and agile project management the picture is similar. A significant difference in scope change issues could not be established between these two project management approaches, which was less strong but similar to that previously reported for traditional project management, which was also not significant at a P-value of $P = 0{,}239$ (compared to the $P < 0.05$ threshold defined in this research). This may be the case because some agile aspects and tools such as short cycle sprint approaches are also used in hybrid project management.
In general, these data do not suggest that agile project management has a higher success rate if the rate of scope change is high. That is something of a surprise, since proponents of agile project management emphasise the benefits of this approach in situations of a changing environment and hence this should be investigated further. One reason why this result was obtained may be seen in the difference of sample projects and contexts of the agile projects of this sample: Since one claimed key benefit of agile project management is the ability to work in a more dynamic environment, agile projects are already applied in more difficult situations. Hence, the existing scope problems of agile projects, as reported by project managers in this study, may lead to "comparing apples and oranges", unlike the more stable situations in which traditional project management are located.

8.12 Prioritizing of task and activities (PT)

Significance of Prioritizing of task and activities (PT)

Prioritisation of task is a crucial prerequisite to managing the challenges of the 'magic triangle' (see Section 3.1). Hence, it can be concluded that failing to prioritize tasks has a negative impact on project success as measured by the Project Success Criteria (PSC), which is also a significant factor (see Table 8.50). This corresponds to the findings of Racheva et al., (2010) that prioritization and reprioritization are important elements in project management practice and hence an important factor.

Table 8.50: Significance of the factor of Prioritizing of task and activities (PT)

	t	df	Sig. (2- tailed)	Mean Difference
Prioritizing of task and activities (PT)	-20.756	272	**0.000**	-1.073

279 responses were recorded in the survey of which six were excluded due to missing or inconsistent data, resulting in 273 valid records. As Table 8.51 summarises, approximately one third of project managers on this survey, 35.1 %, reported that the prioritizing of task and activities issues was either always or quite often an issue in their projects. When the supporting Likert Scale items are taken into consideration, the cumulative percentage increases to 75.1%. This result is in line with the literature (see Section 7.5 and Racheva et al., (2010), O'Sheedy, (2012) and Cobb, 2015), which argues that prioritisation is a relatively critical project management success factor. Hence more prioritisation is carried out in projects, the better is it for the success of the project work.

Table 8.51: Response distribution of the factor of Prioritizing of task and activities

Prioritizing of task and activities (PT)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	12	4,3	5.4	5.4
	2	69	25.7	25.3	29.7
	3	124	45.4	45.4	75.1
	4	63	22.6	23.1	98.2
	5	5	1.8	1.8	100.0
	Total	273	97.8	100.0	
Missing	System	6	2.2		
Total			279	100.0	

Differences of significance of the prioritizing of task and activities (PT) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	Hypothesis	Direction
Prioritizing of task and activities (PT)	H12a (PT): (T+>A+) H12b (PT): (H+>A+	T+, H+, A+

The analysis of the collected data produced the following results:

Table 8.52: Mean by project management approach for the factor of Prioritizing of task and activities (PT)

Prioritizing of task and activities (PT)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	115	**2.85**	0,87	0.31
Hybrid	100	**2.89**	0,99	0.34
Agile	58	**3.14**	1.43	0.46
Total	273			

As expected, there are differences in how often prioritization issues are observed between the project management groups. Traditional project management has most prioritization issues, followed by hybrid project management approaches, which are similar in nature. This is in line with the hypothesis that there are more prioritization issues using traditional project management approaches than using agile H12a (PT): (T+>A+): 2.85 vs. 3.14 and also many more prioritization issues in hybrid approaches than in agile project management H1b (PT): (H+>A+): 2.89 vs. 3.14.

Table 8.53: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of PT

	Prioritizing of task and activities (PT)	
Mann-Whitney U	2779.500	2488.500
Z	-1.907	-1.584
Asymp. Sig. (2-tailed)	0.056	0.113
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to differences between the project management approaches and the prioritization factor, the significance for the factor of prioritization is not entirely clear. In research question 2, when project managers were asked whether traditional or agile project management were more suited to prioritisation, a majority of 51% believed that agile project management was superior to traditional project management.

However, when the number of issues with regard to this factor was checked, a significant difference between traditional and agile project management could not be established although the numerical difference is very large. It is not significant at the level set of $P = 0.056$ (compared to the $P < 0.05$ threshold defined in this research) although very close to it. However, due to the numerical difference, one can conclude that the embedded agile approach to deal with prioritisation issues is very likely to have a positive impact on this success factor, although these data are not strongly statistically significant.

Comparing differences between hybrid and agile project management produces a picture which is less clear. A significant difference in prioritization issues could not be established between these two project management approaches, a less strong but also less clear result than the previously reported value for traditional project management and not as significant at a P-value of $P = 0{,}113$ (compared to the $P < 0.05$ threshold defined in this research).

Nevertheless, although not statistically significant, the data indicate that agile project management seems to benefit the prioritization of project tasks Hartman, and Ashrafi (2002), Adam and Prostean, 2013, Shokri-Ghasabeh and Kavousi-Chabok (2009). This is not entirely surprising, for agile project management has (with the backlog instrument) a prioritization mechanism embedded in the project management approach.

8.13 Resource conflicts or deprivations (RC)

Significance of Resource conflicts or deprivations (RC)

According to Shokri-Ghasabeh and Kavousi-Chabok (2009), the availability of resources is one of the most critical project success factors. This can be replicated with the survey data, as shown in Table 8.54.

Table 8.54: Significance of the factor of Resource conflicts or deprivations (RC)

	t	df	Sig. (2- tailed)	Mean Difference
Resource conflicts or deprivations (RC)	-25.019	271	**0.000**	-1.423

Seven items were excluded from the raw data due to missing or inconsistent data, resulting in 272 valid records. As one can see in Table 8.55, most project managers in this survey, 58.8 %, reported that resource conflicts issues are either always or quite often an issue in their projects. When the ‘occasionally’ category is included, the cumulative percentage increases to 85.9%. This result corresponds with the literature (see Section 7.5 and Shokri-Ghasabeh and Kavousi-Chabok (2009) and Adam and Prostean, 2013) which argues that the availability of resources is a critical project management success factor. Hence the more consistent resources are available, the better it is for the successful completion of a project as measured by the PSC.

Table 8.55: Response distribution of the factor of Resource conflicts or deprivations (RC)

Resource conflicts or deprivations (RC)						
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	37	13.3	13.6	13.6
	2	86	30.8	31.6	45.2
	3	108	38.7	39.7	85.9
	4	37	13.3	13.6	98.5
	5	4	1.4	1.5	100.0
	Total	272	97.5	100.0	
Missing	System	7	2.5		
Total			279	100.0	

Differences of significance of Resource conflicts or deprivations (RC) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	**Hypothesis**	**Direction**
Resource conflicts or deprivations (RC)	H13a (RC): (T->A-) H13b (RC): (T->A-)	T-, H-, A-

The analysis of the collected data produced the following results:

Table 8.56: Mean by project management approach for the factor of Resource conflicts or deprivations (RC)

Resource conflicts or deprivations (RC)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	113	2.55	1.22	0.48
Hybrid	99	2.40	1.23	0.51
Agile	60	2.92	1.14	0.39
Total	272			

In line with the literature, there are differences in how often resource issues are observed in the project management groups. Hybrid project management has most resource issues, followed by traditional project management approaches. This is in line with the hypothesis: that there are more resource issues using traditional project management approaches than using agile H13a (RC): (T->A-): 2.55 vs. 2.92 and also more resources issues in hybrid approaches than in agile project management H13b (RC): (T->A-): 2.55 vs. 2.92.

Table 8.57: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of RC

	Resource conflicts or deprivations (RC)	
Mann-Whitney U	2621.000	1938.000
Z	-2.615	-3.885
Asymp. Sig. (2-tailed)	0.009	0.000
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to differences between the project management approaches in terms of resource conflicts, the significance for the factor of planning and deadlines is very clear. A significant difference between traditional and agile project management could be established at the level set of $P = 0.009$ (compared to the $P < 0.05$ threshold defined in this research).

When comparing differences between hybrid and agile project management the picture is also clear. A significant difference in resource issues could be established between these two project management approaches, which was less strong but similar to the previously reported value for traditional project management as well as not significant at a *P*-value *P* = 0,000 (compared to the *P* < 0.05 threshold defined in this research).

As we saw, the data indicate that agile project management seems to confer clear benefits when it comes to resource allocation in projects. Because the philosophy of agile project management is to have dedicated teams and a focus on business value (Adam and Prostean, 2013), an instrument is embedded in this project management approach to focus and to dedicate efforts (and hence also resources) to the work, which clearly benefits the factor of resource conflicts or deprivations (RC). This prioritisation technique is significantly different for agile project management, a finding in line with the literature (Hartman, and Ashrafi (2002), Adam and Prostean, 2013, Shokri-Ghasabeh and Kavousi-Chabok (2009)). Hence, when prioritisation is especially important, e.g. due a very dynamic environment, the use of *pure* agile approaches has a positive impact on the likelihood of successfully completing the project work.

8.14 Planning and deadlines (PD) a.k.a. level of project planning

Significance of Planning and deadlines (PD)

The analysis of the mean of the planning and deadlines (PD) factor as equal to or greater than 4 has a significance of 0; hence the Null hypothesis (H0) is rejected (that there are not many planning and deadlines issues), while the alternative Hypothesis (H1) is accepted that there are serious planning issues and they are quite prevalent. As with the previous factors, this factor too can have a negative impact on project success as measured by the Project Success Criteria (PSC).

Table 8.58: Significance of the factor of Planning and deadlines (PD)

	t	df	Sig. (2- tailed)	Mean Difference
Planning and deadlines (PD)	-25.205	273	**0.000**	-1.325

Of the 279 records two items had been excluded due to missing or inconsistent data resulting in 274 valid records. As can be seen in Table 8.59, most of the project managers on this survey, 51.1 % reported that planning issues are either always or quite often an issue on their projects. The result increases to 83.6%. when all the relevant positive feedback items are included. In the literature, similar findings are recorded, for instance, Misra et al. 2009 reported that project reporting and monitoring contribute to project delivery in line with the magic triangle constraints. Hence Ahimbisibwe et al., 2017 also argues that planning is an important project success factor. More planning is thus beneficial to projects, a conclusion which supports the likelihood that a project will be successfully completed with it than without it.

Table 8.59: Response distribution of the factor of Planning and deadlines (PD)

Planning and deadlines (PD)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	25	9.0	9.1	9.1
	2	90	32.3	32.8	42.0
	3	114	40.9	41.6	83.6
	4	39	15.0	15.2	97.8
	5	6	2.2	2.2	100.0
	Total	274	98.2	100.0	
Missing	System	5	1.8		
Total			279	100.0	

Differences of significance of Planning and deadlines (PD) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	Hypothesis	Direction
Planning and deadlines (PD)	H14a (PD): (T+>A+) H14b (PD): (H+>A+)	T+, H+, A+

The analysis of the collected data produced the following results:

Table 8.60: Mean by project management approach for the factor of Planning and deadlines (PD)

Planning and deadlines (PD)	**Number**	**Mean**	**SD**	**Coefficient of Variation (CoV)**
Traditional	115	**2.56**	0,94	0.36
Hybrid	99	**2.67**	1.14	0.43
Agile	60	**2.92**	1.25	0.43
Total	274			

As expected, how often planning and deadlines issues are observed varies between the project management groups. Traditional project management has most planning and deadline issues, followed by hybrid project management approaches. This is in line with the hypothesis that there are more planning and deadlines issues using traditional project management approaches than using agile H14a (PD): (T+>A+): 2.56 vs. 2.92 and also more planning and deadlines issues in hybrid approaches than in agile project management H14b (PD): (H+>A+): 2.67 vs. 2.92.

Table 8.61: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for factor PD

	Planning and deadlines (PD)	
Mann-Whitney U	2738.500	2547.000
Z	-2.369	-1.606
Asymp. Sig. (2-tailed)	0.018	0.108
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

With regard to the differences between the project management approaches and the planning factor, the significance for the factor of planning is clear when comparing traditional with agile project management. A significant difference between traditional and agile project management could be established and is significant at the level set of $P = 0{,}018$ (compared to the $P < 0{,}05$ threshold defined in this research).

Comparing differences between hybrid and agile project management gives less clear results. A significant difference in planning issues could not be established between these two project management approaches; it was quite strong when comparing figures numerically but not significant at the P-value of $P = 0{,}108$ (compared to the $P < 0.05$ threshold defined in this research).

This could be explained by the fact that hybrid project management uses many agile planning tools, such as Kanban boards and product backlogs, which suggests that hybrid project management used the best fitted tools and techniques of both the agile and the traditional practices, adjusted to each context (the “best fit approach”). Timinger (2017) argues similarly that using hybrid approaches brings the benefits of agile project management to the project management organisation without compromising established processes and structures.

8.15 Understanding of complexity and interdependencies (CI)

Significance of Understanding of complexity and interdependencies (CI)

We saw from the discussion in section 7.5 that in environments of high complexity and fast pace change, according to some researchers, traditional project management approaches are no longer effective (Sanchez et al., 2019, Conforto et al., 2016, Boehm and Turner (2004), in contrast to the conventional plan-based, agile development methods developed to react to changes and uncertainties in requirements and to reduce the costs of change during projects (Cockburn and Highsmith, 2001). Table 8.62 shows that this factor is also significant in the present study. Hence, this factor was also further researched.

Table 8.62: Significance of the factor of complexity (CI)

	t	df	Sig. (2- tailed)	Mean Difference
Understanding of complexity and interdependencies (CI)	-23.773	273	**0.000**	-1.354

In total the survey data yielded 279 records of which five items were excluded due to missing or inconsistent data, resulting in 274 valid records. In Table 8.63, most project managers in this survey, 55.1 %, are shown to have reported that complexity and interdependencies issues are either always or quite often an issue in their projects. When the ‘occasionally’ category is included, the cumulative percentage increases to 81.8%. This result is very strongly in line with the literature (see Chapter 3.2) which argues that complexity is a critical factor in project management success. Hence more management of complexities is advantageous for projects; this supports the probability that a project will be successfully completed by managing complexity as measured by the PSC.

Table 8.63: Response distribution of the factor of understanding of complexity and interdependencies (CI)

Understanding of complexity and interdependencies (CI)					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	32	11.5	11.7	11.7
	2	87	31.2	31.8	43.4
	3	105	37.6	38.3	81.8
	4	46	16.5	16.8	98.5
	5	4	1.4	1.5	100.0
	Total	274	98.2	100.0	
Missing	System	5	1.8		
Total			279	100.0	

Differences of significance for the understanding of complexity and interdependencies (CI) between project management approaches

Hypothesis as defined in section 7.5:

Critical Success Factor in Projects	Hypothesis	Direction
Significance of Understanding of complexity and interdependencies (CI)	H15a (CI): (A->T-) H15b (CI): (A->H-)	T-, H-, A-

The analysis of the collected data produced the following results:

Table 8.64: Mean by project management approach for the factor of Understanding of complexity and interdependencies (CI)

Significance of Understanding of complexity and interdependencies (CI)	**Number**	**Mean**		**SD**	**Coefficient of Variation (CoV)**
Traditional	113	**2.65**		1.19	0.44
Hybrid	100	**2.63**		1.00	0.37
Agile	61	**2.67**		1.24	0.45
Total	274				

However, what was not expected in these data is that they do it show many differences in how often project complexity issues can be observed between the project management groups. Originally it was hypothesised that agile project management has more complexity issues, due to the absence of upfront planning, although the results of research question 2 suggest that little difference on this point. Most of the 52% of project managers surveyed believed that the project management approach has no impact on managing complexity. The statistical result of the data confirms this and shows that there is no major difference between the project management approaches in this regard.

More complexity issues with agile project management approaches than with traditional and hybrid project management were expected H15a (CI): (A->T-): 2.67 vs. 2.65 and also more complexity issues with hybrid approaches compared with agile project management H15b (CI): (A->H-): 2.67 vs. 2.63. The data in absolute terms do not show any major difference; hence this result shows quite strongly that the choice of project management approach is no different in its success in dealing with the factor of complexity.

Table 8.65: Mann-Whitney U test results of comparing traditional and hybrid with agile project management for the factor of CI

	Understanding of complexity and interdependencies (CI)	
Mann-Whitney U	3443.000	3037.000
Z	-.012	-.048
Asymp. Sig. (2-tailed)	0.991	0.962
Grouping Variable: PM Group	Significance when comparing traditional project management with agile project management	Significance when comparing hybrid project management with agile project management

Therefore, unlike the findings of some authors (Ahimbisibwe et al. (2017), Sanchez et al., 2019) about differences between project management approaches in dealing with the factor of complexity, no differences were observed in the data for this study. Thus, a significant difference between traditional and agile project management could not be established at all and is not significant at all at the level set of P = 0,991 (compared to the $P < 0.05$ threshold defined in this research).

To compare differences between hybrid and agile project management yields similar results. A significant difference in complexity could not be established between these two project management approaches, and the result was also not significant al all at a P-value of $P = 0.962$ compared to the $P < 0.05$ threshold defined in this research.

Hence, the choice of project management approach seems not to influence how complexity issues can be managed. This result, although statistically significant should be researched further, especially to better understand when it makes sense to use which project management approach. Traditional project management tries to cope with complexity by sophisticated planning and depth planning, while agile project management deals with complexity by reacting to new insights with a flexible adjustment of project activities and tasks. As we noted in section 5.4.2., the liminal Cynefin gives us some guidance on environmental situations. In cases of high complexity, the framework suggests applying parallel, low cost safe-to-fail experiments (Snowden, 2019). In agile terms this translates as using multiple parallel sprints and retrospectives to determine the right direction, approach and finally a solution.

8.16 Summary of key findings

The research has shown that the mixing of established traditional and agile project management approaches is widespread in practice and is even increasing, as shown by the move towards hybrid frameworks in project management associations (such as PMI's recently launched disciplined Agile framework). In the following section the findings of this research are summarized.

Research objective 1/ Question 1:

How widely are traditional and agile project management practices used?

- The vast majority of project managers assign themselves neither to the classic nor to fully agile camp (only approximately 5% consider themselves at each of these extremes).
- 41% of the respondents in this research use mainly traditional project management approaches, while 21% lean more towards agile project management. An increasing number, representing 37% see their company/ organization as a hybrid project management organization, meaning project management frameworks are combined and chosen according to the situation and the need for change at the time.
- Almost 80% of all respondents stated that they used project management methods, process models or tools in combination. Only about 20% stick to only one project management framework in its original form and adhere to one project framework with its own standards and practices. These 20% refuse to combine it with other project management frameworks and seem to reject the notion of hybrid project management.

How are these two approaches used and combined?

- The main combination pattern is the traditional waterfall with other project management approaches (53%). Other major combination patterns are a combination with Scrum (19% and Kanban 14%) practices. Quite often traditional waterfall project management is combined with Design Thinking (7%) and Lean project management practices (6%).

- Turning to the agile perspective, Scrum is mainly enriched by Lean project management practices (10%) or Design Thinking (5%) but also by DevOps practices (5%).
- The rest of the combination patterns are only marginally used (often below 2% of the participants indicated other combination patterns).
- With regard to combination pattern, this research revealed that most people use an integrative approach (91%), followed by parallel approaches (79%). Only a smaller proportion choose a sequential integration approach to hybrid project management (66%)

Research objective 2/ Question 2:

Which challenges get better addressed by traditional and which are better addressed by agile project management?

This research question aimed to determine if there are differences between the two approaches and identify existing challenges highlighted from both the traditional perspective and that of agile project management.

- The clearest finding is that agile project management is believed to be more suitable for environments where the scope is liable to change and thus the requirements are not clearly defined. This is in line with what the literature suggests is one of the key benefits of agile project management. Hence also issues with unclear project goals or requirements are believed to be better addressed by agile project management, a belief which can also be confirmed with research. Interestingly however, this could not be replicated when the factors were researched under research question 3.
- Another finding of this research can be described as the superior prioritization management of the agile approach. This is no surprise, since agile project management integrates prioritization in its framework with such tools as backlog grooming, sprints and planning poker, in line with the literature.
- A further advantage of agile project management is a better result in the management of factor expectation, because it defines clear roles to represent the customer on the project
- Agile project management addresses issues with deadlines better, exploiting the sprints' use of time-boxed activities. This reduces delay, but products

delivered by an agile project may have fewer features than traditionally planned projects can offer.

- However, the research showed that traditional project management benefits by managing risk better than agile project management does, although this could not be replicated when the factor was investigated by means of inferential statistics under research question 3.
- For the other factors, no clear superiority of either project management approach can be derived and they are still good topics for further research (see also the section on recommendation for future research).

<u>Research objective 3/ Question 3:</u>

Is there any significant difference between the Traditional, Agile and Hybrid project management approaches concerning the Critical Success Factors (CSFs)?
By using the defined CSF, this research question investigated these differences by comparing the Traditional, Agile and Hybrid project management approaches.

With regard to the CSFs in project management, all the 4 categories of the 15 critical success factors selected from the literature were replicated, although the results varied in strength.
Organisational factors (OF) can be fully replicated and show that they are relevant for successful project management. The factor of communication stands out especially as the second strongest factor in this category, as the literature confirms. With regard to Team factors (TF) the picture is less clear, for soft factors can absorb multiple personal and environmental influences. The most significant factor in this category is accountability. Team skills can also be considered important, although weaker by far. Team dynamics and building teams emerge as the weakest factor in this category.
Customer & stakeholder factors (C&SF) form a similarly strong factor category to OF, with goals or requirements (GR) being the strongest factor influencing project success, closely followed by stakeholder support and engagement a.k.a. management support (SS). The solution fit factor, although significant, is less so than the previous ones.

Project uncertainty factors (PUF) also have a strong significance. Scope changes (SC) is for this research the most significant factor overall, followed by resource conflicts or deprivations (RC), giving PUF third place in terms of critical success factors overall, followed by planning and deadlines (PD). Complexity (CI) is thus also an important success factor for projects, but the least important one in this group.

When considering *differences in project management approaches*, comparing traditional and hybrid project management with agile project management, these 15 factors do not generally seem to make a significant difference to project success, with the following exceptions:

Stakeholder Support (SS) is significantly different with agile management from its effect with both traditional and hybrid project management. The reason lies in the embedded customer representation as part of the agile approach.

Solution fit (OS) is significantly different for traditional project management and for agile project management. The reason is that traditional approaches very statically produce solutions according to a *specification* and not necessarily to a solution fit. Hybrid project management integrates this aspect better and hence is closer to the benefits of agile project management.

Prioritising of task and activities (PT) as a factor in traditional and hybrid project management is also not the same as it is in agile project management. The reason probably lies in embedded and integrated resource planning as part of any agile sprint planning; consequently, fewer issues are reported on agile projects.

The factor of Planning and deadlines (PD) is significantly different in traditional and in agile project management, because traditional approaches assume a quite inflexible process (facing project change requests) for adjusting to situations with new plans and hence make it impossible to cope with project adjustments swiftly and flexibly. Hybrid project management seems to integrate this aspect better than agile project management does.

Team skills (TS) is a significant factor in the comparison of Hybrid and Agile project management, a surprising result, given that the overall absolute figure is better for hybrid than for traditional project management. The variation, however, is much greater in hybrid approaches. Comparing traditional project management with agile, the factor has some numerical indication, but this is not significant.

Team dynamics (TD) is significantly different in hybrid project management and in agile project management but no significant difference can be determined when one compares traditional project management with agile or hybrid, although the latter has some numerical indication.

Both factors (TS and TD) show rather weak results. This is due to the variation in the responses, which is rather high compared to the other factors. Hence it is suggested that this factor should be analysed and researched further; the terms ‘team skills’ and ‘team dynamics’ are rather broad concepts and these factors may represent too many aspects to be precise. Therefore, further research is suggested on this factor in project management as discussed in more detail in Section 10.3. In the following Table 8.66, a summary of research question 3 is presented:

Table 8.66:Summary of statistical difference in project management approaches

Factor[16]	**Project Management Approach**			**Comparing findings of this research of hybrid project management with the reviewed literature**
	Traditional compared to Agile	***Hybrid compared to Agile***	***Traditional compared to Hybrid***	
1. **Communication** (CO)	SAME but some strong numerical indication (p-value: 0.079)	SAME but some strong numerical indication (p-value: 0.094)	SAME No numerical indication (p-value: 0.885)	Although statistically significant differences for the factor Communication (CO) could not be found (different to Ahimbisibwe et al. (2014), some strong numerical indication can be observed that agile project management is different with regard to this factor. Hybrid project management is in this regard closer to traditional project management (p-value: 0, 885).
2. **Clarity in organising change** (OC)	SAME but some numerical indication (p-value: 0.127)	SAME no numerical indication (p-value: 0.875)	SAME But some numerical indication (p-value: 0.069)	Statistically significant differences for the factor Clarity in organising change (OC) could not be established (different to Wysocki, 2019 that agile methods deal with dynamic changes and uncertainty better than traditional projects), although some numerical indication points into that direction (p-value: 0,127). Hybrid project management is in this regard closer to agile project management (p-value: 0,875).
3. **Risk management** (RM)	SAME no numerical indication (p-value: 0.711)	SAME no numerical indication (p-value: 0.547)	SAME no numerical indication (p-value: 0.779)	There are no statistically significant differences for the factor Risk management (RM) which could be established from this study. Hence, a lower risk management performance for agile project management by the level of reported challenges based on improper risk management/contingency plans (Walczak and Kuchta, 2013) could not be replicated.
4. **Accountability** (AC)	SAME no numerical indication (p-value: 0.281)	SAME no numerical indication (p-value: 0.661)	SAME No numerical indication (p-value: 0.476)	Statistically significant differences for the factor Accountability (AC) (a.k.a. team commitment) could not be established, which is in line with findings from Ahimbisibwe et al. (2017).

[16] Refer to Appendix 6 for further statistical details

	Traditional compared to Agile	*Hybrid compared to Agile*	*Traditional compared to Hybrid*	
5. **Team dynamics/team building** (TD)	SAME no numerical indication (p-value: 0.45)	DIFFERENT yes, significant at p-value 0.018	SAME Some strong numerical indication - (p-value: 0.056)	Statistically significant differences for the factor Team dynamics/team building (TD) could be established between agile and hybrid project management but neither between traditional and agile project management nor between traditional and hybrid project management, although the later had some strong numerical indication. It cannot be explained at this stage why Hybrid project management is different, hence further research is suggested for this factor (see also section 9.3).
6. **Team skills** (TS)	SAME some numerical indication (p-value: 0.123)	DIFFERENT yes, significant at p-value 0.027	SAME No numerical indication (p-value: 0.371)	Statistically significant differences for the factor Team skills (TS) could be established between agile and hybrid project management but neither between traditional and agile project management nor between traditional and hybrid project management. Similar to previous finding of Team dynamics / team building (TD), it cannot be explained at this stage why hybrid project management is different, hence further research is suggested for this factor (see also section 9.3).
7. **Stakeholder support and engagement** (SS)	DIFFERENT significant at p-value 0.027	DIFFERENT significant at p-value 0.023	SAME No numerical indication (p-value: 0.955)	Statistically significant differences for the Stakeholder support and engagement could be established in line with Moe et. al. (2010) and Rubin, (2012) on stakeholder involvement. Hence hybrid project management does not seem to be significantly different in this respect from traditional project management. Hence, for this factor, hybrid project management seems to be closer to traditional project management than to agile project management, which is also supported by the Helena (2017) study.
8. **Goals or requirements** (GR)	SAME No numerical indication (p-value: 0.896)	SAME no numerical indication (p-value: 0.649)	SAME No numerical indication (p-value: 0.446)	With regard Goals or requirements (GR), the factor is similar for all three project management approaches. This is different to other studies which have found a difference between traditional and agile project management (see Chapter 2.3 and specifically Munassar and Govardhan, 2010 and Wysocki, 2019) which could not be replicated in this study.

	Traditional compared to Agile	***Hybrid compared to Agile***	***Traditional compared to Hybrid***	
9. **Solution fits in with the organisation** and its stakeholders (OS)	DIFFERENT significant at p-value 0.032	SAME but some numerical indication (p-value: 0.091)	SAME No numerical indication (p-value: 0.477)	This confirms the findings of Jun et al. (2011) who also showed that the early conflicts – more often an issue in traditional organised projects – resulting from the larger stakeholder involvement in agile project management positively affected the project success with this approach. With this, the findings of Ahimbisibwe et al. (2017) could also be replicated. The finding that hybrid project management does not return a significant result can probably be inferred from the fact that hybrid project management uses agile and traditional tools; hence there are no clear differences between hybrid and agile projects with regard to this factor but a numerical indication of similarity (p-value: 0,091).
10. **Clarity in expectation management and deliverables** (EM)	SAME some numerical indication (p-value: 0.181)	SAME no numerical indication (p-value: 0.570)	DIFFERENT significant at p-value 0.020	Comparing differences between hybrid and agile project management produces no clear picture with regard to Clarity in expectation management and deliverables (EM) factor could be established. Hence, an significant difference for the factor of clarity in expectation management and deliverables could not be found comparing this factor to agile project management and traditional project management. The numerical difference is even bigger when comparing hybrid with agile project management. This implies that for this factor, hybrid project management is actually not closer to agile project management. The Helena study (Helena, 2017), showed that planning and configuration management is used in a more traditional way, while the activities around the requirements of engineering, implementation, integration, and testing tend to be observed with agile project management approaches could explain the differences, i.e. the *adjustment to the situation* of hybrid project management explains why there is a difference when comparing Traditional to Hybrid project management but is the same when compared to agile project monument (higher p-value: 0,570).

	Traditional compared to Agile	***Hybrid compared to Agile***	***Traditional compared to Hybrid***	
11. **Scope changes** (SC)	SAME no numerical indication (p-value: 0.569)	SAME No numerical indication (p-value: 0.239)	SAME No numerical indication (p-value: 0.451)	Statistically significant differences for the factor Scope changes (SC) could not be established in the study. This is in line with Ahimbisibwe et al. (2017) who also could not confirm this the superiority of agile project management.
12. **Resource conflicts or deprivations** (RC)	SAME some strong numerical indication (p-value: 0.056)	SAME some numerical indication (p-value: 0.113)	SAME No numerical indication (p-value: 0.208)	There are no statistically significant differences for the factor Resource conflicts or deprivations which could not be established from the study, although there is some strong numerical indication that agile project management is superior with regard to the is CSF at p-value: 0.056. Although not significant in this study, this support findings of other researchers that agile technique is superior with regard to resource management (Hartman, and Ashrafi (2002), Adam and Prostean, 2013, Shokri-Ghasabeh and Kavousi-Chabok (2009)).
13. **Prioritizing of task and activities** (PT)	DIFFERENT significant at (p-value 0.009)	DIFFERENT significant at p-value 0.000	SAME No numerical indication (p-value: 0.733)	This prioritisation technique is significantly different for agile project management, a finding which is in line with the literature (Hartman, and Ashrafi, 2002, Adam and Prostean, 2013, Shokri-Ghasabeh and Kavousi-Chabok, 2009).

	Traditional compared to Agile	***Hybrid compared to Agile***	***Traditional compared to Hybrid***	
14. **Planning and deadlines** (PD)	DIFFERENT significant at p-value 0.018	SAME some numerical indication (p-value: 0.108)	SAME No numerical indication (p-value: 0.361)	With regard to the differences between the project management approaches and the planning factor (PD), a significant difference when comparing traditional with agile project management could be established. A significant difference between Hybrid and Agile project management could not be established. The same hold true comparing Traditional and Hybrid project management. Timinger (2017) argues that using hybrid approaches brings the benefits of agile project management to the project management organisation without compromising established processes and structures. The p-value: 0,108 might give some numerical indication of better planning in hybrid projects, but cannot be confirmed statistically that hybrid projects can perform on an agile performance level with data from this study.
15. **Understanding of complexity and interdependencies** (CI)	SAME no numerical indication at all - (p-value: 0.991)	SAME No numerical indication at all - (p-value: 0.962)	SAME No numerical indication (p-value: 0.960)	In this study, there were no statistically significant differences for the factor complexity and interdependencies (CI) and the choice of project management approach found. This is different to Highsmith (2010), who argues that an increase in complexity, structure and discipline provided by traditional project management approaches is superior to Agile project management. Hence, Ahimbisibwe et al. (2017) conclude that complexity has a greater negative effect for agile projects compared with traditional based project methodologies. This could also not be replicated for Hybrid projects.

9. Interdependencies between the project management CSF by project management approach (Correlation Analysis)

9.1 Introduction

The aim of this chapter is a correlation analysis of the previously used 15 CSFs from Chapter 8, based on the previously introduced data collection (see Chapter 7). This additional study aims at determining the interdependency of the CSFs, which are a measure of their importance for project success. The interdependency is determined by quantitative strength of each CSF based on their correlations with each other.

This adds another perspective to the work of the previous chapter to understand which factors reinforce each other. Originally a regression analysis was envisioned to complement the previous analysis in Chapter 8. However, it was found that predictions of exact relationships between the CSF is of little practical use. It is practical and helpful to have a good understanding of which factors are reinforcing or weakening each other but exact predictions via e.g., a logistic regression would have little practical application on how to choose the right project management approach as every environment is different and hence this information can only be indicative. Secondly it needs to be noted that many project managers cannot actually choose the project management approach independently due to existing corporate project governance imposed by project management offices (PMOs) (see Aziz, 2014, Komus, 2017b and PMI, 2017). In this case an analysis using a regression model makes little sense if a project manager has no control and hence no choice over the PM method.

In terms of the methodological approach, the statistical procedures have to fulfil two objectives: identifying the success factors and determining their relative influence on each other. In order to be able to make reliable statements about which factors cause different degrees of success, the methods that are used must be able to explain the differences in some dependent variables from those in other dependent variables. Which method is ultimately suitable depends on the characteristics of the success variable. If the dependent variable has a scale, correlation analysis can be used in success factor research. Privitera (2018) justifies the use of correlation analysis on ordinal-scaled data as provided by Likert scales, although this a matter of debate (Murray 2013, Norman, 2010, Green and Salkind, 2012). However, it is an accepted practice to use Likert scales in correlation analysis, especially in social science research, when Likert scales contain 4 or more points (Green and Salkind, 2012).

A general interest in project success factors has become apparent, as the literature review shows (see Chapter 3). Investigating the topic of CSF interdependency specifically should be worthwhile, not least because the success factors of projects can vary with the type of project (Dvir et al. 2003). This implies that organisational projects are likely to have other success factors than, for example, software, HR or even construction projects; hence different project management approaches become more or less effectual. As we have seen, a review of the literature showed a research gap in the interdependency of CSFs especially when comparing traditional, agile and hybrid project management. As with CSF for hybrid project management in general, only a few empirical studies on the *interdependency* of project management CSF have so far been published.

Two studies with surveys of project managers and project staff do question critical success factors or ask generally about success factors in projects and their multivariate perspective (Dvir et al. 2003 and Cremer 2002). However, no evaluation has been made according to the types of project management approach, i.e. no evaluation gives any clues as to which of the factors has a particularly important effect on the others. Hence, the present study explored the interdependency of success factors of different project management approaches using the data collected in the online survey, which was also used to identify the importance of the CSF as laid out in Chapter 8.

The complementary question to the research carried out in Chapter 8 was: Are the effects of these influencing factors different with regard to different project management approaches?

This is an exploratory, not a hypothesis-testing addition to complement the hypothesis-testing study of Chapter 8. Hence, it highlights the interrelation of CSF for traditional, agile and hybrid project management, a combination which was considered in research for the first time.

9.2 Discussion of findings of interdependencies between the project management CSF

In the following section, the correlations of each factor broken down by the project management approach are presented. The focus of this review is on the strongest correlations. The full set of data is available in Appendix 8.

Scope changes (SC)

The concept of traditional project management is that of a sequential conception for the project dynamics (Sanchez et al., 2019). Boehm and Turner (2004) highlight that a successful project under the traditional project management approach relies on fully defined, upfront requirements, deliverables and planning. Schedules and milestones must be defined because the project management processes are supposed to be followed as strictly as possible; exceptions are shown as deviations from predetermined plans. If changes are not included in the original definition of the project, scope changes (SC) need to be incorporated during the course of the project. As we saw in the previous chapter, Scope Changes (SC) might problematically lead to the misinterpretation of a requirement or to a new requirement (Sharma et al., 2012). They could also result in an increased effort to coordinate, which requires more time (O'Sheedy, 2012). Traditional project management, however, relies from the outset on a common understanding (by means of specifications) of the work to be delivered (Wysocki, 2019). However, in many projects not all the requirements and deliberations can be identified or specified at the beginning of a project (Wysocki, 2019), due to the many unknown requirements and gaps in the “how to do” dimension (see also the underlying complexity theory and Cynefin framework). Hence it is not surprising, that for traditional projects Scope changes (SC) has a high correlation to Communication (CO), Stakeholder support and engagement (SS) and
Goals or requirements (GR) factors (see Table 9.1). When compared with agile and hybrid project management, it becomes evident that the latter two correlate to the factors more weakly. This is not surprising, since specifically agile project

management deals proactively with deviations and allows new requirements as part of the integral project management approach.

Table 9.1: Correlation Matrix for Scope changes (SC) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Scope changes (SC)	1.000	1.000	1.000
	Communication (CO)	**.482**	.186	.062
	Stakeholder support and engagement (SS)	**.400**	.223	.153
	Goals or requirements (GR)	**.399**	**.249**	**.291**
	Accountability (AC)	**.318**	**.412**	.200

Practical implications:

For traditionally run projects, the factors Communication (CO) and Stakeholder Support (SS) and Goals or requirements (GR) have a high correlation to Scope changes (SC) and hence these factors should be observed closely. For instance, a change in the scope of the traditional projects should be strengthened by more communication activities (explanations of reasons, rationale, impact) than that in agile and hybrid projects. The same holds true for the stakeholder and goals or requirement factors.

Interestingly, for agile projects, accountability (AC) has the strongest correlation. This is in line with previous findings, since agile project management relies heavily on self-organising teams (see section 2.2.1 Scrum). Hence missing accountability in an agile project set-up has the most detrimental effect with regard to scope changes (see also Hoegl and Gemünden (2001)).

Communication (CO)

Communication is defined as the practices that increase the exchange of information and with this also improve cohesion not only among team members but also with other stakeholders. Many papers have revealed that communication is one of the most critical success factors in project management (e.g., Rajkumar, (2010), Binder (2007), Kliem (2008)). The Standish Group in its study of project management and its success factors have identified that communication factors such as lack of stakeholder input, incomplete or changing requirements and/or specifications are key communication issues in projects and are shown to affect the likelihood of project success (Hastie and Wojewoda, 2015) and also previous findings on Scope changes (CO). As shown in Table 9.2, there is a close correlation between factor Communication (CO) and Stakeholder support and engagement (SS) for all project management approach exits, although traditional project management has the closest correlation, followed by agile project management. This holds true as well to a lesser degree for hybrid project management.

The study confirms the paradigm of modern project management systems that communication is the key to all and stakeholders should be involved in project management. Hence, there is consensus that communication and links to Stakeholder support and engagement (SS) are among the most critical success factors in project management (Rajkumar 2010, Binder 2007, Kliem, 2008) which is also strongly supported by the following correlation results:

Table 9.2: Correlation Matrix for Communication (CO) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Communication (CO)	1.000	1.000	1.000
	Stakeholder support and engagement (SS)	**.579**	**.490**	**.332**
	Inadequate prioritizing (PT)	**.574**	.185	-.019
	Clarity on how to organize the change (OC)	**.494**	**.433**	.074
	Accountability (AC)	**.460**	.381	.369

For traditionally run projects, the factors Communication (CO) and Stakeholder Support (SS) are highly correlated. This time inadequate prioritizing (PT) has the second highest correlation for traditionally managed projects. For agile and hybrid projects, this is less marked and in line with the findings of research question 2: 51% of project managers when asked whether traditional or agile project management was more suited to prioritisation, replied that agile project management was superior.

Thus, prioritisation is a more important CSF for traditionally managed projects and somewhat less important for agile and hybrid projects, because prioritisation mechanisms are embedded in the project management approach. Interestingly no clear correlation could be established for hybrid project management due to the use of both traditional and agile tools in combination.

Consequently, especially for traditionally run projects, prioritization efforts should be managed carefully. This holds also true for factors such as Clarity on how to organize the change (OC) for agile project management – and hybrid project management, to a much lesser degree. Accountability (AC) has rather a medium correlation for all three project management approaches and should be observed closely, especially in traditionally organised projects.

Practical implications:

Accountability (AC) and Stakeholder support and engagement (SS) are factors which are equally important for all three project management approaches and hence overall one of the most important CSFs, which is in line with previous findings (see section 8.4 and 8.7). Inadequate prioritizing (PT) is more important for traditional management projects than for agile or hybrid management projects.

Stakeholder support and engagement (SS)

Stakeholders are individuals or organisational units with a vested interest in a project. In traditional project management approaches, there is an agreement between the client and the project manager which forms the basis of the relationship and clearly regulates the requirements. The greatest weakness of the relationship appears if the agreement contains insufficient details which cannot be realized (Boehm and Turner, 2003). Agile methods use the functioning software to build trust; traditional methods work with the maturity of the processes used (Boehm and Turner, 2003). In agile project management, the focus and the interaction with the end user and other stakeholders is much more distinct throughout the project from the very beginning. For instance, in Scrum the product owner representing the customer side has been institutionalized, as we saw in section 5.3.2. The task of the product owner is to know the exact interests of the users and stakeholders so as to represent them consistently (Rubin, 2012).

Table 9.3: Correlation Matrix for Stakeholder support and engagement (SS) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Stakeholder support and engagement (SS)	1.000	1.000	1.000
	Communication (CO)	**.579**	**.490**	**.332**
	Solution fit (OS)	**.547**	.278	-.089
	Team dynamics (TD)	**.490**	.031	-.020
	Accountability (AC)	**.488**	**.360**	.251
	Scope changes (SC)	**.482**	.186	.062
	Clarity on how to organize the change (OC)	**.473**	.450	.003

Hence, it is not surprising that for traditionally run projects, the factors Communication (CO) and Solution fit (OS) have the highest correlation. This is in line with the findings of research question 3 (see sections 8.1 and 8.9). What is outstanding in the correlation analysis is that Team dynamics (TD) has the third highest correlation for traditionally managed projects. This may be due to the fact that agile project management is based on the notion of empowered and self-organising teams focusing on collaboration, which is different in traditionally managed projects. Certain agile practices such as co-location, stand-ups or retrospectives are considered to overcome the traditional project management challenges of team dynamics (Smite et al. 2010). This is confirmed by many researchers, e.g. Ramesh et al (2006), Paasivaara et al. (2009), Hossain et al. (2009). Hence for agile and hybrid project management this is not as important a factor as it is for traditional project management approaches.

Practical implications:

In addition to the already highlighted factors of Communication (CO) and Solution fit (OS), the factor Team dynamics (TD) is more important in traditionally managed projects with regard to its relation to Stakeholder support and engagement (SS) activities. Hence, because traditional project management relies more on formal communication, team dynamics should be closely observed.

Goals or requirements (GR)

A clear and realistic definition of the project goals or requirements should be worked out in the project definition and be part of the project initiation process and its documents. It is widely accepted that the more clearly defined the goals or requirements are, the better for the project result (Ika et al. 2012, Serra and Kunc 2014 and Taherdoost and Keshavarzsaleh 2016).

In traditional project management approaches, there is a “contract” between the customer and the developers which forms the basis of the relationship and clearly regulates the requirements. The greatest weakness of the relationship appears if the contract contains either too few or too many details which cannot be represented in practice due to assumptions which do not materialize (Boehm and Turner, 2003).

Agile and hybrid project management use a different approach in which requirements are only roughly defined especially at the beginning of a project and allows some requirements to remain unclear.

Hence it is not surprising in traditionally organized projects that the factor Goals or requirements (GR) correlates closely with the factors Inadequate prioritizing (PT), Clarity on expectation management (EM) and How to organize the change (OC). In agile and hybrid project management, the correlation for Inadequate prioritizing (PT), is much lower, indicating that this factor is much more important for traditionally managed projects. With regards to Clarity on expectation management (EM) and How to organize the change (OC) however, agile project management is closer to traditional project magnet with regard to factor correlations.

Table 9.4: Correlation Matrix for Goals or requirements (GR) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Goals or requirements (GR)	1.000	1.000	1.000
	Inadequate prioritizing (PT)	**.500**	.186	.275
	Clarity on expectation management (EM))	**.454**	**.541**	.276
	How to organize the change (OC)	**.431**	**.534**	.121

Practical implications:

In additional to the already highlighted factors Communication (CO) and Stakeholder support and engagement (SS), the factor Goals or requirements (GR) is more important in traditionally managed projects. This supports the notion that hybrid project management can be used less stable situations as described in the Cynefin framework. On the contrary, this also supports the idea of using traditional project management in more stable situations; in contrast to this hybrid project management is suitable for conditions of uncertainty (Vinekar et al, 2006) mainly “Complex” situations (Snowden, 2019, Snowden, 2017 a/b, West et al., 2011, Kerzner 2014, Wysocki 2019). However, it should be noted that Clarity on expectation management (EM) and How to organize the change (OC) factors are particularly important for agile projects relative to the sensitivity of the Goals or requirements (GR) factor.

Accountability (AC)

Accountability (AC) focuses on the reliability of responsible individuals on a project. There are differences how the Accountability (AC) factor correlates between the project management groups (see Table 9.5). As shown in Section 8.4 traditional project management suffers more from accountability issues, followed by hybrid project management approaches. Hence it is not surprising to see that that agile and hybrid project management have a lower correlation of accountability issues. While there is high correlation on Stakeholder support and engagement (SS) and Communication (CO) factors, as shown previously, it is remarkable to see the factor Solution fit (OS) also standing out as the factor having the highest correlation with accountability.

Table 9.5: Correlation Matrix for Accountability (AC) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Accountability (AC)	1.000	1.000	1.000
	Solution fit (OS)	**.524**	**.327**	.021
	Stakeholder support and engagement (SS)	**.488**	**.360**	.251
	Communication (CO)	**.460**	**.381**	**.369**

Practical implications:

In addition to importance and the already highlighted factors Communication (CO) and Stakeholder support and engagement (SS), the factor Solution fit (OS) correlates most closely with Accountability (AC) in traditionally managed projects. The factor Solution fit (OS) is also especially important for traditional project management since traditionally organised projects have more solution fit issues (see Section 8.9). Jun et al. (2011) showed that early conflicts – more often an issue in traditional organised projects – frequently stem from the lack of ownership and responsibility issues which cannot be allocated to a predefined role in the traditional project management approaches (uncertainty over who is responsible for what in a project). Hence the establishment of clear roles and responsibilities and an institution of conflict resolution are especially important for traditionally organized projects. In agile or hybrid projects the importance of self-managed teams needs to be established to reduce the potential for problems.

Clarity on how to organize change (OC)

Clarity in ways of organising change (OC) is defined as planning certainty and the required clarity in organising change to ensure the successful delivery of a project. According to Schopka, traditional project management controls are appropriate for short projects with services of smaller scope. The longer and larger the project, the more complex the planning and thus also more control over projects is required as they become increasingly complex. This results in multiple activities, many tasks and complex interrelations. Since traditional project management is based mainly on hierarchical and linear relationships, research has shown that it can cope with only a certain amount of complexity (Cicmil et al., 2009, Spundak 2014).

Hence it is not surprising to find high correlation with the Solution fit (OS) and to a lesser degree with the Complexity (CI) factors. The latter is more closely correlated with agile projects. This may be explained by the less need for planning with agile projects, which makes the interdependencies less obvious – although this research could not establish any significant difference with regard to the factor complexity (CI) (see the findings of section 8.15). As with many factors in this research, Communication (CO) and Stakeholder support and engagement (SS) are among the crucial relationships, as is the Goals or requirements (GR) factor. It is somewhat surprising that Goals or requirements (GR) correlate more in agile projects than in traditional projects in relation to Clarity in the organization of change (OC) factor, because the proponents of agile management stress the fact that it can much better deal with undetermined goals or requirements (e.g., Wysocki, 2019). Perhaps this reconfirms the previous finding in Section 8.2: that the significance of agile superiority for factor OC was not great, although a numerical difference was observable.

Table 9.6: Correlation Matrix for Clarity on how to organize the change (OC) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Clarity on how to organize the change (OC)	1.000	1.000	1.000
	Solution fit (OS)	**.507**	**.436**	.188
	Communication (CO)	**.494**	**.433**	.074
	Stakeholder support and engagement (SS)	**.473**	**.450**	.003
	Inadequate prioritizing (PT)	.445	.360	.245
	Complexity (CI)	.438	**.525**	.199
	Goals or requirements (GR)	.432	**.534**	.121

Planning deadlines (PD)

Project planning and deadlines relate to the extent of project planning and controlling practices used in a project. More planning of tasks and activities implies better project results (Ramesh et al., 2012, Yetton et al., 2000, Ahimbisibwe et al., 2017).
According to Schopka (2015), financial control departments have to acknowledge the limits of planning and control in projects; they must accept that certain aspects are not yet planned and actively participate in new ways of agile thinking, aware that not all project plans can be determined in detail and controlled against, and with this embrace the agile mindset to cope with an increasingly dynamic environment.

The traditional project management process is organised sequentially on linear sequencing. Predictability and control (the clear link between performance and costs in a “magic triangle” – see also Chapter 3 and Atkinson, 1999) are the key characteristics of traditional project management approaches. The overall objective is to efficiently produce a pre-defined end product under the given restrictions without allowing much flexibility to cope with changes. Hence, the concept of traditional project management is that of a sequential conception for the project planning (Sanchez et al., 2019). Boehm and Turner (2004) highlight that a successful project under the traditional project management approach relies on fully defined, upfront requirements, deliverables and planning. Schedules and milestones must be defined because the project management processes are supposed to be followed as strictly as possible; exceptions are shown as deviations from predetermined plans. Independent reviews and checks verify whether a given way of managing a project complies with project management standards and guidelines (Sanchez et al. 2019, Snow et al. 2007).

For the factor Planning deadlines (PD), the correlation analysis shows that there are similar correlations for traditional and agile project management and to a lesser extent for hybrid project management with regard to Expectation management (EM). This holds true also for factor Complexity (CI) for both traditional and agile project management, but, interestingly, not for hybrid project management.

Table 9.7: Correlation Matrix for Planning deadlines (PD) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Planning deadlines (PD)	1.000	1.000	1.000
	Expectation management (EM)	**.441**	**.453**	.247
	Complexity (CI)	**.390**	**.338**	.065

Practical implications:

For the factor Planning deadlines (PD) the factor Expectation management (EM) is very important. This is intuitive, since time is one of the most important project success criteria. For more information, please refer to the next section, where the factor Expectation management is reviewed.

An important influencing factor for Planning deadlines (PD) holds true also for factor Complexity (CI) for both traditional and agile project management, but interestingly not for hybrid project management. This could relate to the strength of hybrid project management, discussed above. The adaptability of this approach to different situations is marked. As a practical takeaway for project managers, traditional and agile project management are similarly correlated. This however contradicts the significant difference between traditional and agile project management with regard to Planning deadlines (PD) (see Section 8.14) to the extent that correlations seem to be similar.

Expectation management (EM)

Expectation management (EM) measures what a project (outcome) delivers in relation to what is expected, i.e. more clarity in what is expected and should be delivered is better for a project's results).

When analysing interfactorial correlations, solution fit (OS) and Goals or requirements (GR) are highly correlated with Expectation management (EM). This is not surprising because it measures related factor categories. When project goals or requirements are correctly defined and interpreted during the project life-cycle, a good solution fit can be achieved. What is slightly more surprising is that there is a close correlation with the factor of Planning deadlines (PD). The reason is that the time needed for project delivery is one of the most important aspects of the Success Criteria, as discussed in Section 3.1, and one of the three major dimensions (Aguanno, 2005; Ika, 2009, Joslin and Müller, 2015; Serrador and Pinto, 2015, Cooper 2016). The time dimension in project management is about the periods and points in time that are relevant to a project. It measures how much time is needed to implement the project and what milestones can be achieved and made available from the project efforts (Atkinson, 1999). Hence it follows that the factor Expectation management (EM) correlates closely with the Planning deadlines (PD).

Table 9.8: Correlation Matrix for Expectation management (EM) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Expectation management (EM)	1.000	1.000	1.000
	Solution fit (OS)	**.487**	**.495**	.166
	Goals or requirements (GR)	**.454**	**.541**	.275
	Planning deadlines (PD)	**.441**	**.453**	.247

Practical implication:

Not surprisingly, to deliver what is expected from a project the Solution fit (OS) factor has the highest correlation followed by Goals or requirements (GR). This is self-explanatory, for the better the goals are derived from what is expected, the better the solution fit develops and the better the factor of what is expected from a project can be fulfilled. As we have seen in the previous section, Planning deadlines (PD) and Expectation management (EM) has a high correlation especially in traditionally and agile managed projects and to lesser degree for hybrid projects, since time is an important Critical Success Criteria (see section Expectation management (EM)). Practically, this implies that when high customer and / or stakeholder satisfaction is sought, the focus should not only be on creating the right solution (represented by Solution fit (OS)) with corresponding and correctly derived objectives (Goals or requirements (GR)) but also attention should be paid to the promised timing of the project deliverables (Planning deadlines (PD)).

<u>Inadequate prioritizing (PT)</u>

While traditional project management applies traditional controlling methods, which make use of regular target-performance comparison, this procedure is changed with an agile approach and allows much quicker adjustments. With an agile approach, prioritisation can swiftly respond to a change in requirements and priorities (Schopka, 2015, Vinekar et al., 2006). As a result, performance progress is directly visible, i.e. it does not have to be assumed, as would be required by the traditional project management approach. This is achieved with the embedded prioritisation mechanism within the agile project management approaches (see 2.2.1 backlog).

At the same time, one of the key characteristics of traditional project management approaches is to efficiently produce a pre-defined end product under the given restrictions without allowing much flexibility to cope with changes. Hence there are differences in correlations for the factor Communication (CO). While this correlation is strong for traditional project management, it is weak for both agile and hybrid project management. This also holds true to some extent for the factors Goals or requirements (GR) and Clarity on how to organize the change (OC), although stronger correlations can be observed for both agile and hybrid project management as well. Stakeholder support and engagement (SS) is less well correlated for agile and hybrid project management. The reason may be the lesser reliance on formal communication, as introduced in Section 2.3.

Table 9.9: Correlation Matrix for Inadequate prioritizing (PT) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Inadequate prioritizing (PT)	1.000	1.000	1.000
	Communication (CO)	**.574**	**.185**	**-.019**
	Goals or requirements (GR)	**.500**	**.328**	**.276**
	Clarity on how to organize the change (OC)	**.445**	.360	.245
	Stakeholder support and engagement (SS)	**.428**	.182	.159

Practical implications:

The research shows that for the factor inadequate prioritizing (PT), there is a high correlation for traditional project management with regard to the factors Communication (CO), Goals or requirements (GR), Clarity on how to organize the change (OC) and Stakeholder support and engagement (SS). While clear Goals or requirements (GR) and Clarity on how to organize the change (OC) are important factors for all projects (albeit to a lesser extent for agile and hybrid project management) it becomes clear that prioritisation issues need to be paid attention to with adequate communication, especially in traditionally run projects. In addition, the Stakeholder support and engagement (SS) is also more closely correlated with traditional projects, implying that communication and stakeholder management are also especially important for dealing with prioritisation issues in traditionally run projects.

Team dynamics (TD)

Traditional project process models tend to work with authoritarian leadership and top-down decisions, whereas in an agile environment a cooperative management style prevails and teams' decisions are made under a more democratic model (Goleman, 2000, Moe et al. 2010). In the agile project management approach, the manager acts as mentor and representative of the stakeholders towards the team, whereas in the traditional project management environment, the manager plans, decides and controls the milestones of the project (McManus, 2007). This has an impact on the factor of Team dynamics (TD). In addition, the composition of the team varies, depending on the project management approach and this has an impact on team dynamics as well. In a traditional project management environment, the team is normally composed along the lines of functional responsibility and characterized by a high degree of specialization: in agile methods, teams are composed according to skills and interests and are designed to run on interdisciplinary knowledge (Moe et al.2010).

Traditional and agile project management make use of fundamentally different management structures and leadership roles as well as team compositions. For both, there are also opportunities and risk areas at the personnel level. For example, traditional project process models tend to work with authoritarian leadership and top-down decisions, whereas in an agile environment a cooperative management style prevails and teams' decisions are made under a more democratic model (Goleman, 2000, Moe et al. 2010). In the agile project management approach, the manager acts as mentor and representative of the stakeholders, whereas in the traditional project management environment, the manager plans, decides and controls the milestones of the project (McManus, 2007). The composition of the team also varies, depending on the project management approach in a traditional project management environment, the team is normally composed along the lines of functional responsibility and characterized by a high degree of specialization: in agile methods, teams are composed according to skills and interests and are designed to run on interdisciplinary knowledge (Moe et al.2010).

As we have seen in Section 2.2.1, the most important agile method, Scrum, focuses on phases of reflection within the reviews or retrospectives, in which decisions are made together and customer feedback is quickly absorbed (Paasivaara et al. 2009). With Scrum this is often accompanied by an increase in productivity, since employees are more satisfied, the quality of the implemented codes is higher, and transparency regarding the status of product development is given to all participants (Rothman and Kilby 2019). Through the cross-functionality of teams, knowledge can be exchanged quickly and purposefully, ideas are coordinated in a timely manner and administrative bodies do not stand in the way of creativity (Moe et al.2010). If functions do not prove their worth, they can be quickly and cost-effectively eliminated and problems and conflicts can be identified and discussed without delay (Paasivaara et al. 2009). Moreover, in Scrum teams employees sometimes take on tasks that do not directly correspond to their core competencies – which can also lead to increased knowledge generation and the further training of the employees themselves (Paasivaara et al. 2009).

Agile project management is based on the notion of empowered and self-organising teams focusing on collaboration. Certain agile practices such as co-location, stand-ups or retrospectives are considered to overcome the traditional project management challenges of inflexibility (Smite et al. 2010), a finding which is also confirmed by many researchers, e.g. Ramesh et al (2006), Paasivaara et al. (2009), Hossain et al. (2009). However, all of the current studies have been carried out under the idealistic assumption of organisational settings, which all comply fully with the requirements of the respective agile methods. For instance, in Scrum co-location is required. In today's business set-up where a huge amount of IT support is outsourced to off-shore locations, these requirements cannot be met. This has an impact on the effectiveness of the agile method, as confirmed by Batra (2009). At the same time, the distribution of teams across different continents is increasing, clearly limiting the effectiveness of agile approaches further, as reported in the venture one agile study (VersionOne, 2020).

Table 9.10: Correlation Matrix for Team dynamics (TD) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Team dynamics (TD)	1.000	1.000	1.000
	Solution fit (OS)	**.578**	**.446**	**.386**
	Stakeholder support and engagement (SS)	**.490**	.031	-.020
	Complexity (CI)	**.447**	**.301**	-.012
	Inadequate prioritizing (PT)	**.418**	.160	-.007

Practical implications:

The Solution fit (OS) factor has for all 3 reviewed project management approaches a rather high correlation with factor of Team dynamics (TD), implying that consensus on the right approach or solution approach is important for this factor in all projects.

This is different when comparing the factor of Team dynamics (TD) with the Stakeholder support and engagement (SS) factor. As highlighted in the previous finding, here too Stakeholder support and engagement (SS) seems be important for traditionally run projects, but less important for agile and hybrid project management. Team dynamics need also to be observed, when a project is extremely complex. These dynamics may have a negative impact on project success, along with issues of inadequate prioritizing (PT).

Solution fit (OS)

Scrum teams focus on interim deliverables in which 'added value delivered' to the customer is preferred to exact adherence to what has been agreed, discussed and documented upfront (O'Sheedy, 2012). Under the agile/scrum paradigm, the lessons learnt need not wait until the end, but are instead recorded during so-called retrospective meetings so their substance can be incorporated in the next sprint iteration. Therefore, the process followed in this paradigm is iterative and flexible, as opposed to the linear model used in traditional project management frameworks, such as the Waterfall model (Grushka-Cockayne et al., 2015).

The specification at the very beginning of a traditionally managed project is what will be provided during the implementation (Chow and Chao 2008). Only at the end of this process is the overall product accepted and actually used (see Figure 9, 1 blue line). In agile project management work is made available in releases and work is made available many times in the course of the project's life-cycle (Highsmith and Cockburn, 2001 and see also Figure 9.1, green line). A potentially first, early version of the product is provided to begin with (O'Sheedy, 2012). The customer can view and evaluate a product (although with limited features) from the very start and provide early directions (O'Sheedy, 2012). Based on his/her feedback, in an agile approach the original plan gets adjusted. This ensures a continuous regular dialogue with the customer; as a result there is less risk of developing a product which does not fulfil his/her customer requirements (Caccamese and Bragantini, 2012). The utility of the product for the customer increases gradually with every iteration (Sharma et al, 2012).

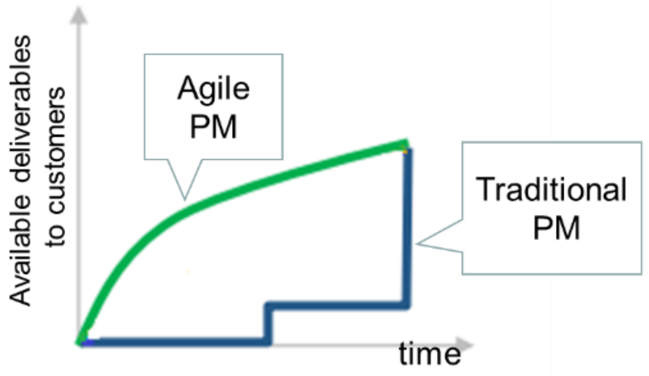

Figure 9.1: Agile vs. Traditional Project Management: Deliverables to customer over time
Source: Adapted from Strasser (2019)

Reviewing this aspect from a correlation perspective and comparing the three different project management approaches, one observes the highest correlation of the Solution fit (OS) factor with a variety of factors. Hence it can be concluded that there are not only a few factors that have an impact on the Solution fit; in fact, multiple factors influence this dimension. Team dynamics (TD) and Stakeholder support and engagement (SS) play the most vital role, followed by Accountability (AC) and Clarity on how to organize the change (OC).

Table 9.11: Correlation Matrix for Solution fit (OS) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Solution fit (OS)	1.000	1.000	1.000
	Team dynamics (TD)	**.578**	**.446**	**.386**
	Stakeholder support and engagement (SS)	**.547**	.278	-.089
	Accountability (AC)	**.524**	.327	.021
	Clarity on how to organize the change (OC)	**.507**	**.436**	.188
	Clarity on expectation management (EM)	.487	**.495**	.166
	Complexity (CI)	.447	**.521**	.287

Practical implications:

The factor Solution fit (OS) has the highest correlation with the so-called soft factors of Team dynamics (TD), Stakeholder support and engagement (SS), and Accountability (AC). It is important to manage these soft factors together to support a good solution. Disagreement on the best-fit solution, for example can quickly lead to negative impacts on other soft factors such as Accountability (AC), Clarity on how to organize the change (OC) and Clarity in expectation management (EM). For agile project management Complexity and solution are closely correlated (please see the section on Complexity (CI) below).

<u>Risk management (RM)</u>

Fabricius and Büttgen (2015) conclude that the ability to realistically evaluate project risks makes a significant contribution to the overall success rate of projects. Because agile methods treat risk by increased agility (reacting to situations rather than mitigating them upfront) and not by the traditional project management approaches to risk management of increasing procedures, reporting and contingency plans, it can be assumed that there is less risk management in agile projects due to the lack of formality in this regard.

In a previous section, Section 8.3, no evidence was found for the view that agile projects entail less risk management due to the lack of formality. Hence it is no surprise to see the correlation analysis confirms this finding with regard to complexity. In the correlation analysis, moreover, no difference of risk is found between traditional and agile project management that is caused by high project complexity. A rather lower correlation can be found for hybrid projects. With regard to Resource conflicts or deprivation (RC), traditional project management is highly correlated with regard to this risk factor; however the correlation is much lower for agile and hybrid project management.

Table 9.12: Correlation Matrix for Risk management (RM) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Risk management (RM)	1.000	1.000	1.000
	Complexity (CI)	**.475**	**.453**	.266
	Resource conflicts or deprivation (RC)	**.393**	.011	.260

Practical implications:

Complexity is an important driver of the risk management factor for both traditional and agile projects, but less so for hybrid managed projects. In times of high uncertainty, hybrid project management is the preferable approach.

Resource conflicts or deprivation (RC)

As highlighted in the previous section, the factor Resource conflicts or deprivation (RC) is closely correlated to the factors of Risk management (RM) and Team skills (TS) in traditionally managed projects. For agile projects, Resource conflicts or deprivation (RC) has the lowest correlation. This can be explained by the embedded prioritisation mechanisms that are part of the agile project management approach. This holds less true for hybrid project management, which has a lower correlation and, in this regard seems, to be closer to traditional project management. In addition, Team skills (TS) closely correlate with Resource conflicts or deprivation (RC).

Table 9.13: Correlation Matrix for Resource conflicts or deprivation (RC) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Resource conflicts or deprivation (RC)	1.000	1.000	1.000
	Risk management (RM)	**.393**	.011	.260
	Team skills (TS)	**.320**	.198	.181

Practical implications:

The factor Resource conflicts or deprivation (RC) has some correlation with Risk management (RM) in traditional and hybrid organised projects, but no correlation in agile projects. This can be explained by the better prioritisation in agile projects and corresponds to the hypothesis finding, as previously discussed in Section 8.13

Complexity (CI)

According to Wysocki (2019), projects of high uncertainty and complexity where solutions are "often not known at the outset" do well to use the agile process model (Wysocki, 2019, p. 499). However as reported in Section 8.15, no differences between the various project management approaches in dealing with the factor of complexity and risk (represented by factor Risk management (RM)) could be found. Using the correlation data, it is also clear that, confirming the previous finding, no differences can be found between traditional and agile project management. For hybrid project management the correlation is, however, lower. Team dynamics (TD) correlate more closely in traditional project management. This can be explained by the planning approach, since the upfront planning of the entire project is increasingly complex and hence prone to more adjustments, which has a negative impact on team dynamics (TD). The factors Solution fit (OS) and Clarity on how to organize the change (OC) show high correlation for both traditional and agile project management, with the latter having higher correlations with regard to the Complexity factor. It is worth noting that hybrid project management has lower correlations for all factors with regard to complexity.

Table 9.14: Correlation Matrix for Complexity (CI) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Complexity (CI)	1.000	1.000	1.000
	Risk management (RM)	**.475**	**.453**	.266
	Team dynamics (TD)	**.447**	.301	-.012
	Solution fit (OS)	**.447**	**.521**	.287
	Clarity on how to organize the change (OC)	**.438**	**.525**	.199

Practical implications:

There are no differences in dealing with complexity for either traditional or agile project management. This is in line with the previously reported differences (see Section 8.15) between project management approaches in dealing with the factor of complexity. Moreover, no differences in the analysis of correlations could be observed in the data for this study. For project managers, this means that the factor of complexity needs to be addressed by other means, for instance, by means of the modularisation / scoping of project planning. The fact that hybrid project management has lower correlations may be explained by its ability to better adjust to situations, enabling it to deal better with project complexity.

<u>Team skills (TS)</u>

Team skills (TS) describe the qualification of the team for a certain project task or activity, i.e. the competence available to the project team for the project. More team skills on the project team are better for project results. The correlation analysis reveals that all three approaches are no different in with regard to solution fit, but a high correlation can be confirmed for all three project management approaches, suggesting that the skills of a team are the key driver for the right solution fit. To a lower degree, Team skills (TS) correlate with Team dynamics (TD). This correlation is higher for traditional and hybrid projects, indicating that the dynamics of team skills and team dynamic issues are less prevalent and correlated in agile projects.

Table 9.15: Correlation Matrix for Team skills (TS) by PM approach

		Traditional Project Management	Agile Project Management	Hybrid Project Management
Correlation	Team skills (TS)	1.000	1.000	1.000
	Solution fit (OS)	**.401**	**.420**	**.397**
	Team dynamics (TD)	**.329**	.175	**.355**

Practical implications:

Team skills (TS) are the main driver for the right solution fit for all three project management approaches. For management it is important to acknowledge that only a team with right team skills achieves a good solution fit. The reason is that this is main agent for monitoring team dynamics, which are found less often (and therefore correlate less) in agile projects.

9.3 Summary of key findings

The correlation analysis showed in addition to the findings of the individual CSFs that there are differences between the three project management approaches. Some CSFs have correlation patterns which are rather similar, some have correlation patterns that are quite different from the respective other project management approaches. For this summary, the previously introduced CSF *categories* will be used (see Section 3.2 Literature review for Critical Success Factors (CSF) in project management).

<u>Organisational factors (OF)</u>

Comparing traditional with agile project management, the correlation patterns for Organisational factors (OF) are quite dispersed: Some factors are more strongly correlated for both traditional and agile project management such as Clarity in organising change (OC) and Risk management (RM), some are rather more equally important for all project management approaches such as Communication as the following Venn diagram shows in Figure 9.1:

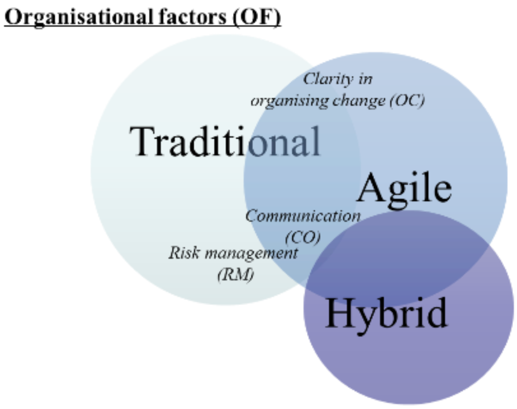

Figure 9.1: Venn diagram of CSF correlation patterns in project management approaches for Organisational factors (OF)

Team factors (TF)

With regards to Team factors (TF) the correlation pattern for Accountability (AC) is quite similar between traditional and agile project management. On the other hand, with regards to Team skills and Team Dynamics factors (TS and TD) a stronger correlation pattern can be observed between agile and hybrid project management as the following Venn diagram shows in Figure 9.2:

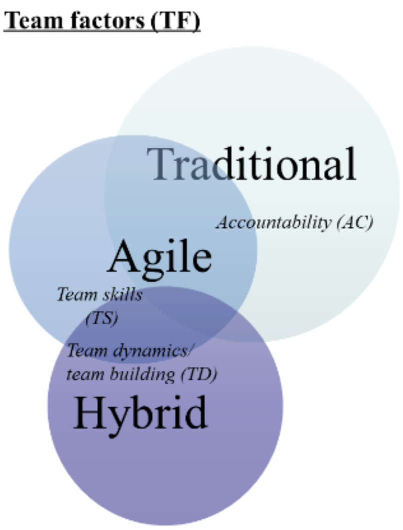

Figure 9.2: Venn diagram of CSF correlation patterns in project management approaches for Team factors (TF)

Customer & stakeholder factors (C&SF)

Concerning the correlation patterns for Stakeholder support and engagement (SS), Solution fit (OS) and Goals or requirements (GR) factors, these are again quite similar between traditional and agile project management. With regards to Clarity in expectation management (EM) and Scope changes (SC), agile and hybrid project management are more similar with regards to their correlation patterns. This is shown in Figure 9.3:

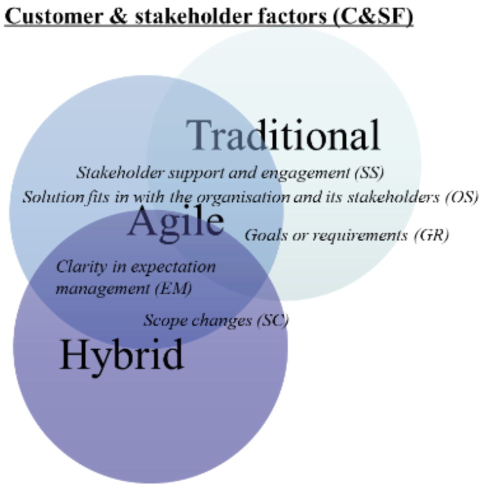

Figure 9.3: Venn diagram of CSF correlation patterns in project management approaches for Customer & stakeholder factors (C&SF)

Project uncertainty factors (PUF)

Project uncertainty factors (PUF) have the least common correlation patterns. Planning and deadlines (PD) and Understanding of complexity and interdependencies (CI) factors are similar between traditional and agile project management. On the other hand, traditional and hybrid project management share similarities in correlation patterns with regard to the Prioritizing of task and activities (PT) factor, while hybrid and agile project management share similarities in correlation patterns for the Resource conflicts or deprivations (RC) factor. The following is represented in the Figure 9.4:

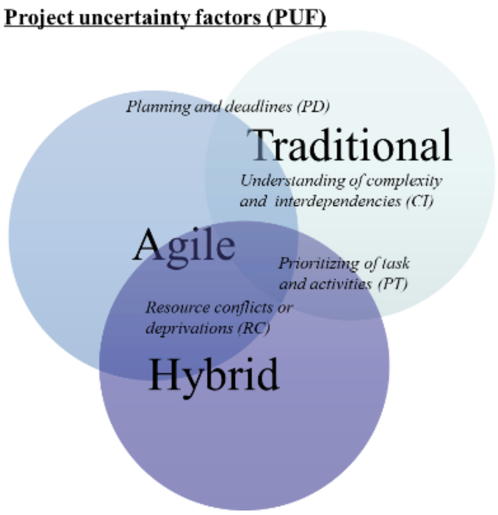

Figure 9.4: Venn diagram of CSF correlation patterns in project management approaches for Project uncertainty factors (PUF)

Comparing correlations of the various CSF to the results from Chapter 8, it becomes apparent that the results from each individual factor and the correlation results differ i.e., individual CSF results and correlation results show different patterns. For instance, the result for factor Communication (CO) from Chapter 8 indicates that there is no significant difference between this factor (although some strong numerical indication) and the project management approach, although in the correlation analysis a difference between traditional compared to hybrid project management can be observed. This means that the correlation analysis provides some additional insights into *how factors influence each other independent from the difference of the factor itself* comparing the different project management approaches.

The overall conclusion of this section is that for hybrid project management, the correlations are often smaller overall, pointing towards the previously discussed ability to *adjust better to changing conditions and changing situations* (see also Chapter 3.4 and 4). It is also clear from the Venn diagrams above that there is a substantially different pattern of related factors in the case of the hybrid PM approach as compared with the two other PM approaches. This shows a distinct and strong clustering of such factors within the hybrid approach that is very different from the profiles of either of the two other approaches. A summary of the findings is presented in the following table 9.16.

Table 9.16: Summary of CSF correlation patterns in project management approaches

	Correlation patterns between factors[17]	Project Management Approach		
Category		***Traditional compared to Agile***	***Hybrid compared to Agile***	***Traditional compared to Hybrid***
Organisational factors (OF)	1. **Communication (CO)**	*Similar*	*Similar*	*Mainly different*
	2. **Clarity in organising change (OC)**	*Similar*	*Different*	*Different*
	3. **Risk management (RM)**	*Similar*	*Mainly different*	*Different*
Team factors (TF)	4. **Accountability (AC)**	*Similar*	*Somewhat similar*	*Different*
	5. **Team dynamics/team building (TD)**	*Different*	*Mainly Similar*	*Different*
	6. **Team skills (TS)**	*Different*	*Somewhat different*	*Somewhat similar*
Customer & stakeholder factors (C&SF)	7. **Stakeholder support and engagement (SS)**	*Somewhat similar*	*Somewhat different*	*Different*
	8. **Goals or requirements (GR)**	*Somewhat similar*	*Mainly Different*	*Different*
	9. **Solution fits in with the organisation and its stakeholders (OS)**	*Similar*	*Similar*	*Different*
	10. **Clarity in expectation management and deliverables (EM)**	*Similar*	*Similar*	*Different*
Project uncertainty factors (PUF)	11. **Scope changes (SC)**	*Mainly different*	*Similar*	*Similar*
	12. **Resource conflicts or deprivations (RC)**	*Different*	*Somewhat similar*	*Somewhat different*
	13. **Prioritizing of task and activities (PT)**	*Different*	*Mainly Similar*	*Similar*
	14. **Planning and deadlines (PD)**	*Similar*	*Similar*	*Different*
	15. **Understanding of complexity and interdependencies (CI)**	*Similar*	*Similar*	*Different*

[17] Refer to Appendix 8 for further statistical details

10. Conclusion

Project managers are confronted with the fact that the previously assumed “one fits all” project management approach does not actually exist and that applying the traditional approach to all project management problems seems to be “out of date” in a so-called ‘VUCA world’ of organisational situations and conditions. Previously project managers followed the traditional Waterfall approach and its variations. Nowadays customers’ requirements, which are often not fully understood, are at the centre of most project endeavours. Agile project management approaches are allowing companies a faster “time to market” and bring the features which are valued by the customer to the centre of the delivery. However, the agile approach cannot be applied for every project deliverable or sub-task. Hence, the project manager in the future will more and more need to use hybrid approaches selecting a “good fit” combination of existing project management techniques and tools.

This sort of project management “customisation” will continue to grow and become more important as time goes on. This, as a consequence requires guidance when to use which project management approach, which is at the heart of this research.

10.1 Conclusion of findings and contribution to the research of project management

The research has shown that a majority of almost 80% of project managers use hybrid project management and the trend has moved away from the application of only *one* “best practice standard”, which can be confirmed in this research. Although all three hybrid combination patterns (sequential, parallel, fully integrated application of a different project management process model) are used, the most widespread combination pattern is the *integrated application of different project management process models* pattern. With regard to combination pattern, the research revealed that the majority of combination patterns stem from the traditional Waterfall project management model which can get enriched by other project management practices (in 53% of the cases). Often agile principles and tools are used to enrich the Waterfall process model. The research showed that the enrichment with Scrum practices is a very common combination pattern, which is mainly used during the delivery or execution of a project (also-called Water-Scrum-Fall combination pattern). The reason for this can be seen in contractual aspects. This is followed by Kanban project management, which is added to traditional project management practices to ensure an optimal flow of the planned tasks. Also, agile project management is using other project management practices. These are mainly coming from Kanban project management and are often enriched by Design Thinking and DevOps practices[18].

This thinking lays the foundation of a *context-driven*, hybrid project management approach, and is providing clear evidence of the departure of the monolithic thinking of project management associations singular "best practice" standards in project management ("one standard fits all"). As we can see in PMI's move to introduce Disciplined Agile (DA), project management associations move towards a new way of working will be a great source for academia to determine if this new approach - away from one best practice - towards a contingent approach can result in better project management performance and a clear advancement in project management practice. This contingent approach should also incorporate correlation findings of Chapter 9, suggesting to combine efforts according to the found correlations.

In the following Table 10.1 the situational criteria / context factors have been added for the use of *hybrid project management* as the main research contribution and conclusion of this research:

[18] Although Design Thinking and DevOps are strictly speaking no project management approaches, these have been added to the questionnaire as research shows (e.g. Helena, 2017) that these approaches are common combination patterns enriching project management approaches

Table 10.1: Situational criteria / context factors for the use of hybrid project management in addition to the traditional and agile project management

Situational criteria (context factor)	**CSF**	**When to use which Project Management approach**		
		Traditional	*Agile*	*Hybrid*
Planning reliability vs. required agility	Planning and deadline (PD) Clarity in describing on how to organise change (OC) Clarity in expectation management and delivery (EM) Communication (CO) Resource conflicts or deprivation (RC) Prioritizing of task and activities (PT)	Top level management requires adherence to plans, fixed and agreed project deliverables (Ahimbisibwe et. al., 2016, Wysocki, 2019, Timinger, 2017, Dvir and Lechler (2004).)	Top level management supports adaptive behaviour and requires adjustments of an optimal project delivery (Sheffild and Lemetayer, 2013, Ahimbisibwe et. al., 2016, Timinger, 2017, Slevin and Pinto (1988), Frey et al. (2009)	• **Top level management supports and requires flexibility for some project deliverables, product components or during certain project stages of the project life-cycle (e.g. development of solutions flexibly with agile project management (requires adjustments of an optimal project delivery) followed by subsequent roll-out activities of the developed solution (adherence to plans, fixed and agreed project deliverables)** • **Separation of agile and traditional project management in sub-projects of the overall project or program: e.g. hardware development followed by traditional project management, software development with agile project management**

Specification, Customer centricity or involvement	Goals or requirements (GR) Stakeholder support and engagement (SS) Solution fit (OS)	Minimally involve users, customer or stakeholder throughout the project life-cycle (Misra et al, 2009, Sheffiled and Lemetayer, 2013)	Integrated involvement of users, customer or stakeholder throughout the project life-cycle, specific representation if customers are highly trained or experienced and willing to participate in project work (Chow and Chao 2008, Misra et al, 2009, Ahimbisibwe et. al., 2016) Ika et al. (2012), Serra and Kunc (2014) and Taherdoost and Keshavarzsaleh (2016)	• **Combination of user involvement in a project or sub-project stage on an "if required" basis**
Interdependency and Complexity situation	Understanding of complexity and interdependencies (CI) Risk Management (RM) Scope changes (SC)	When situations are easily predictable (Ahimbisibwe et. al., 2016) "Obvious" and mainly "Complicated" situations (Snowden, 2019, Snowden, 2017 a/b, West et al., 2011, Kerzner 2014, Wysocki 2019)	In conditions of uncertainty (Vinekar et al, 2006) Mainly "Complex" situations with short episodes of "Chaos" (Snowden, 2019, Snowden, 2017 a/b, West et al., 2011, Kerzner 2014, Wysocki 2019)	• **In changing situations e.g. high uncertainty at the beginning of the project followed by predicable situations e.g. development of project vs. roll-out of product components; adjustment to dynamic environments requiring adaption of project approach with high complexity**
Corporate culture and team mentality	Accountability (AC), Team dynamics / team building (TD), Team skills (TS)	Suitable if project team is characterized and comfortable with less flexible leadership styles (Autocratic Leadership, Bureaucratic Leadership, Transactional Leadership) (Goleman, 2000, McManus, 2007, Moe et al. 2010, Rothman and Kilby, 2019, Hoegl and Gemünden,(2001) Mir and Pinnington (2013), Jun et. al (2011) and Xu et al (2010))	Suitable if project team is characterized and comfortable by flexible leadership styles (Democratic Leadership, Laissez-Faire, Leadership, Transformational Leadership, Coach-Style Leadership) (Goleman, 2000, McManus, 2007, Moe et al. 2010, Rothman and Kilby, 2019, Hoegl and Gemünden, 2001, Mir and Pinnington (2013), Jun et. al (2011) and Xu et al (2010))	• **Suitable if project team is able to adjust to situations and is not bound to one leadership style (team can cope well with adjustments to new environmental situations and switch between leadership styles)**

Summary		(1) the project is simple to complicated, (2) solutions / deliverables are clearly known at the beginning, (3) the project requirements can be fixed e.g. in form of a contract, (4) the work may not be broken down in smaller deliverables (5) close interaction with stakeholders or users is not possible (6) acceptance of autocratic organisational structures	(1) the project is very complicated, mainly complex, partly chaotic (2) solutions / deliverables are not clearly known at the beginning, (3) the project requirements change over time, (4) the work can be broken down in smaller, unknown deliverables (5) close cooperation with stakeholders or users is possible (6) acceptance of self-organisational teams	**(1) the project is moving dynamically from complex to complicated situations over the project's life-cycle** **(2) solutions / deliverables are not known at the beginning but at a later stage which allows the project management approach to be switched** **- or -** **sub-project requires different project management approaches (e.g. hardware vs. software development)** **(3) the project requirements change over a certain period, but at some point allow certain assumptions to be made for subsequent activities (e.g. certain product characteristics)** **(4) the work can be separated into agile and traditional sub-projects, tasks or project life-cycle periods** **(5) both close cooperation with stakeholders or users and the non-involvement of stakeholders is possible (e.g. separation of front end / user facing elements and technical back-end components)** **(6) teams' understanding how to adjust to multiple leadership styles driven by the situational contexts. Teams in different contexts can still cooperate and work on an overall project or program objective**

10.2 Limitations and scope of the research

The researcher believes that there are three main limitations of this research, which can be identified as following: the sample size for the primary data collection of the online survey, industry context and circumstantial appropriateness.

Limited published research is available on hybrid project management in the context of non-IT project management. The data and subsequently the knowledge gained are valid and reliable only to the related PMI German Chapter project management professionals in their individual German contexts. Thus, generalisation with regard to the expert knowledge and population of experts available from the PMI German Chapter (and Germany's industrial focus on engineering, automobile production and services) must be restricted. Furthermore, most of the experts who answered the questionnaire came from mainly PMI and Allianz, the firm which employs the researcher, which entails a limitation in terms of the industry focus and company size (PMI members tend to be employed by larger companies), although analysis of the data does suggest that company size is not an influencing factor (see also Helena, 2017).

Thirdly, circumstantial appropriateness need to be put into perspective. As we have seen from the research, Hybrid Project Management is adjusting project management approaches according to the individual and specific project situation. Although tendencies can be observed (see CSFs or correlation results), one need to keep in mind that each project situation is different with the respective impact on project management effectiveness.

10.3 Transferability of results into daily project management practice

The presented research should be used as guiding principles for the adjustment of traditional and agile project management towards the applied use of hybrid project management to achieve a better fit to the situation and the organisational context. Hence the project manager needs to make some sense-making decisions during the application of the principles established by this research.

For instance in this research it was found that agile project management has clearly a higher effectiveness with regards to delivering better prioritization to projects or product features in the course of the project. If this is of high importance, the project manager should decide to use agile practises (with the respective tools such as product backlogs – see Table 8.66).

Similarly, the correlation analysis can be used to identify CSFs which are reinforcing each other. For example the correlation analysis suggests that for environments with many Scope Changes (SC), the traditional project manager should focus on Communication (CO) and Stakeholder Management (SS) activities whereas the Agile Project Manager should focus on the factor Accountability (AC) of the individual team members (see also Table 9.1).

Hence the results of this research, when to use what kind of project management approach or adjustments towards hybrid project management must be seen as principle based guidance and require some degree of sense-making judgement of the situation by the project manager.

10.4 Recommendation for future research

As we saw during this research, hybrid management is widely used in practice albeit this is not intensively researched yet. Spundak (2014) suggested further research on combining project management frameworks and premises. Some more insights were provided by the Helena study (Helena 2017-2019). As a conclusion of this study further research on hybrid project management around "the correlation between the implemented new roles and the way of working in order to gain insights into advantages and disadvantages, difficulties and experiences with more or less suitable combinations" is recommended.

A contribution has been made with this research especially with regard to combination patterns, however further research is advisable as not many studies exist yet especially with regard to details on each of the project management factors. Especially around the team and uncertainty factors, more insights are advisable.

Hence a couple of areas are recommended to investigate hybrid project management further as a direct result of this research in relation to the 15 factors analysed here. These are described in the following paragraphs.

With regard to the factor clarity how to organise change (OC), it was shown that hybrid approaches make use of agile tools and techniques. Hence the integration and the specific tools used on hybrid projects to cope with uncertainties is an interesting research area with quite some gap in knowledge. Further detailed research to understand *why* hybrid project management is closer to agile project management with regard to this factor is proposed.

With regard to the factor accountably (AC), we saw that the more responsible and accountable team members are on projects, the better it is for project work, however agile project management seems to have *more infrequent accountably* issues compared to hybrid and traditional project management. One reason could be a non-fitting team composition - which seems to only happen infrequently but from time to time, which could have a specifically bad impact on this factor in the agile project management framework. Hence this team factor might be disproportionately more important for agile project management. This is an interesting finding which should be investigated further because it would give strong guidance for project practitioners to pay more attention on team issues compared to traditional project management.

Team dynamics showed weak results in this research as when comparing differences between hybrid and agile project management. A significant difference in team dynamics/team building (TD) issues could be established between these two project management approaches, which is quite strong compared to the previously reported value for traditional project management. The reason for this might be due to the non-stringent use of various project management philosophies, which makes it more difficult to establish a common approach and consensus and philosophy of how to run the project. This could be another interesting research topic for future researchers.

With regard to the project goal and requirements factor (GR), planning and deadlines (PD) but also with regard to the scope change (SC) factor, the result when to use which project management approach gives still ample opportunities to research the *context of projects*. One reason why these results are not as straight forward could be the split of activities which can be planned very well and some which are unclear and do not have clear requirements. To use an adjustment to the situation (see also 5.4 Cynefin

framework) might be a reason to gain better project performance on these factors, which could be researched further so to provide a better knowledge in the context driven aspect of hybrid project management. Therefore, more research in a more controlled environment with projects in similar and comparable situations is suggested to give more insights on *when* agile project management indeed is superior in dynamic environments relatively to the scope change factor. Ideally the same project gets carried out with a respective project management approach in an experimental setting (i.e. similar environment and other factors being controlled).
Hybrid project management is a first step towards this context driven approach. This could be explained by the fact that hybrid project management is using many agile planning tools such as Kanban boards or product backlogs but at the same time is also making use of traditional established good practices. Again, this is an area where more research should be carried out to gain more detailed insights as to when and how hybrid project management is used and applied in practice and why there seems to be some difference when compared to purely traditional project management practices.

Finally, a quite broad topic is the result on project complexity. This result, although statistically significant should be researched further, especially to better understand *when* it makes sense to use which project management approach to tackle complexities and interdependencies: Traditional project management is trying to cope with complexity by sophisticated planning and depth planning, while agile project management is dealing with complexity by reacting to new insights by flexibly adjusting the project activities and tasks. As we have seen in section 3.4.2, the liminal Cynefin gave us some guidance on environmental situations. In cases of high complexity, the framework suggests to apply parallel, low cost safe-to-fail experiments (Snowden, 2017b). In agile terms this translates using multiple parallel sprints and retrospectives to determine the right direction, approach and finally a solution. The effectiveness of both, trying to cope with complexity by improved planning (traditional project management) or via flexibility and swift change capabilities (agile project management) is an interesting area of further research with ample variety of topics to be researched further.

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Appendix 1: Survey Design

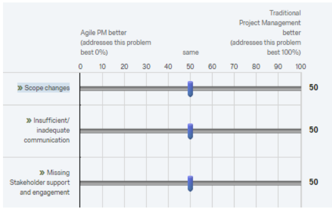
1.1 Pilot Survey: set-up of the pilot survey and feedback on the pilot

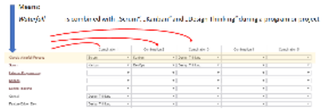
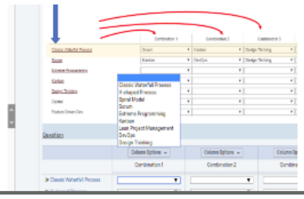
A questionnaire has been designed based on the following steps 1-3. A total number of 6 people have been asked to provide feedback to the questionnaire design and the questions relative to the research objective.

#	Steps to Create Questionnaire	Applied procedure for creating a questionnaire	Comment
1	**Create the prototype for the questionnaire**	• Content review of questions and answers • Formal examination of the questionnaire (layout, type of questions, functionality of online software Qualtrics) for creation of the questionnaire • Creation of cover sheet, including input from data privacy • Instructions and information • Review of flow	• As a starting point the information of the Helena study was used incl. an alignment of questions with research questions. • Experiments with Qualtrics on what kind of graphical representation for which type of question; Feedback from colleagues who carry out corporate surveys was sought during this phase (2 meetings) • The data privacy impact assessment template has been completed. • Has been created as a cover sheet (see link below) • The flow of the survey can be found in Appendix 2
2	**Development of the final form and question selection / item selection**	• Check the question and answer categories for clarity • Item selection • Perform a pre-test	A small number of project professionals in Allianz Group have been asked to give feedback on questionnaire A sample 6 people reviewed questionnaire and gave feedback on form (usability) and question selection/item selection.
3	**Selection of respondents after the questionnaire creation**	The voluntary participants wo reviewed questionnaire also filled the questionnaire after the final questionnaire (see Appendix 2) was created.	All 6 participants of the pilot group filled out the questionnaire

1.2 Changes during pilot and lessons learnt

Based on the previous process, 6 people gave feedback to the initial questionnaire. The questionnaire got 3 iterations before it reached the current state as presented in Appendix 2.

Area	Received feedback	Implemented change
Landing page	Landing page was considered too long Purpose of the study not entirely clear	Check with data privacy on text, the length of the text is required, data privacy details can be linked to University website; added bold character to improve readability Introduction text was reformulated
Flow	If no combination is used all the subsequent questions are irrelevant	Introduced a separation in flow (see Appendix 3) to shorten the questionnaire in case no combination of project management models is applied
Graphical representation of concepts	Questions not clear	Introduced graphical representation of concepts
Project Management models	Definitions of Project Management models not clear or unknown	Introduced hyperlink with definitions 
Design of graphic	Design of graphic difficult to use	Change type of graph e.g. from Slider version:  To matrix table version: 

Instructions	Activity to be done not clear	**Included examples**  **Reduced complexity of questions (e.g. reduction to 3 choices instead of 4)** **Introduced pre-selected drop-down menus** 
Analysis	Questions text difficult to analyse	Introduced coding and codes 

Appendix 1.3: Final Survey Questions

The questionnaire can be reached at the following URL:

https://hwsml.eu.qualtrics.com/jfe/form/SV_2tyWt5wjIOYDBTD

A detailed overview of the questions is presented in the following pages.

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Research on Hybrid Project Management

Which project management approaches do you use?

Please select the ones you use.

Click on the term e.g. Classic Waterfall Process for explanations.

How often used to manage projects?

	(almost) always (100%-81%)	often (80-51%)	occasionally (50%-21%)	not very often (below 20%-1%)	Not at all (0%)	Don't know
Traditional Project Management						
Classic Waterfall Process						
V-shaped Process						
Spiral Model						
Agile Project Management						
Scrum						
Extreme Programming						
Kanban						
Lean Project Management						
Other approaches or tools						
DevOps						
Design Thinking						
Other 1 Other 1						
Other 2 Other 2						
Other 3 Other 3						

← →

Research on Hybrid Project Management

How would you "rate" your project management approach in your organisation: Which approach do you mainly use?

- Fully Traditional
- Mainly Traditional
- Balanced between Traditional and Agile
- Mainly Agile
- Fully Agile

Do you combine project management frameworks, methods, tools or process models?

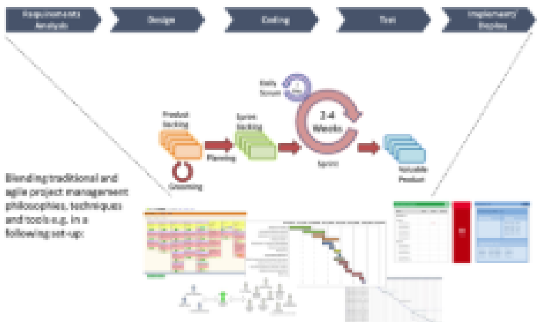
- Yes - we combine project management approaches
- No - we don't combine

← →

<u>How do you combine or adjust project management approaches?</u>

Click selection on the left.

	Often	Sometimes	Never
1. Combination of different project management approaches **in sequence (first ..., then ...)** *e.g. we use first agile to develop a product. The roll-out ("industrialisation") to the customer occurs with a Waterfall approach*	○	○	○
2. Combination **in parallel** Agile and Traditional project management are used in at the same time in an **integrated manner** (overarching program management alignment required) *e.g. hardware part of the product = Waterfall software part of the product = Agile*	○	○	○
3. **Integrate** philosophies, approaches, concepts and tools Agile and Traditional project management are used in an integrative manner: "I as a project manager use various approaches and tools out of my tool box and combine these as needed based on my experience" *e.g. Gantt Charts with Sprints Kanban board as tool in a Waterfall project Daily stand-up in a Waterfall project Steering Commitee for a Scrum project*	○	○	○



Do you have any comment or remark on the way how you combine?

← →

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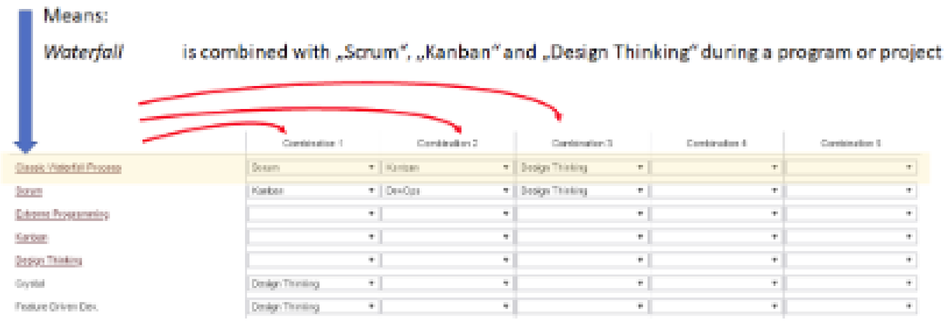
(Sprachauswahl / Language selection)

English - United Kingdom ▼

Which project management frameworks, methods, tools or process models do you combine?

Example



Question

	Combination 1	Combination 2	Combination 3
Klassisches Wasserfall Modell	Scrum ▼	▼	▼
V-Modell	▼	▼	▼
Spiral Modell	▼	▼	▼
Scrum	▼	▼	▼
Extreme Programming	▼	▼	▼
Kanban	▼	▼	▼
Lean Project Management	▼	▼	▼
DevOps	▼	▼	▼
Design Thinking	▼	▼	▼
Other 1	▼	▼	▼
Other 2	▼	▼	▼
Other 3	▼	▼	▼

Do you have any comment or remark on your combination pattern(s)?

→

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(Sprachauswahl / Language selection)

English - United Kingdom ▼

What are your main project management challenges you have encountered?

Please rate the ones you can identify for your company or project management experience and indicate which represents your experiences best.

How often experienced during projects?

	(almost) always (81-100%)	often (51-80%)	occasionally (21-50%)	not very often (below 20%-1%)	Not at all (0%)	Don't know / not sure
Scope changes	○	○	○	○	○	●
Insufficient/ inadequate communication	○	○	○	○	○	●
Missing Stakeholder support and engagement	○	○	○	○	○	●
Missing / Undefined goals or requirements	○	○	○	○	○	●
Lack of accountability	○	○	○	○	○	●
No clarity on how to organize the change	○	○	○	○	○	●
Unrealistic deadlines	○	○	○	○	○	●
Clarity on expectation management and deliverables	○	○	○	○	○	●
Inadequate prioritizing of tasks and activities	○	○	○	○	○	●
Cultural issues (between organizational groups, internationally)	○	○	○	○	○	●
Determining which solution fits to the organization and its stakeholders (e.g. centralized vs. decentralized organization need different solutions)	○	○	○	○	○	●
Improper risk management / contingency plans	○	○	○	○	○	●
Resource conflicts or deprivation	○	○	○	○	○	●
Insufficient understanding of complexity and interdependencies	○	○	○	○	○	●
Issue with team dynamics / team building / team skills	○	○	○	○	○	●
	(almost) always (81-100%)	often (51-80%)	occasionally (21-50%)	not very often (below 20%-1%)	Not at all (0%)	Don't know / not sure

← →

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Research on Hybrid Project Management

(Sprachauswahl / Language selection)

English - United Kingdom ▼

Of the main project management challenges you have encountered, which one do you believe are better addressed
...by Agile Project Management (APM)?
...by Traditional Project Management (TPM)?

Please indicate which represents your experiences best.

	Agile APM much better	Agile APM somewhat better	same	Traditional TPM somewhat better	Traditional TPM much better
Scope changes	O	O	O	O	O
Insufficient/ inadequate communication	O	O	O	O	O
Missing Stakeholder support and engagement	O	O	O	O	O
Missing / Undefined goals or requirements	O	O	O	O	O
Lack of accountability	O	O	O	O	O
No clarity on how to organize the change	O	O	O	O	O
Unrealistic deadlines	O	O	O	O	O
Clarity on expectation management and deliverables	O	O	O	O	O
Inadequate prioritizing of tasks and activities	O	O	O	O	O
Cultural issues (between organizational groups, internationally)	O	O	O	O	O
Determining which solution fits to the organization and its stakeholders (e.g. centralized vs. decentralized organization need different solutions)	O	O	O	O	O
Improper risk management / contingency plans	O	O	O	O	O
Resource conflicts or deprivation	O	O	O	O	O
Insufficient understanding of complexity and interdependencies	O	O	O	O	O
Issue with team dynamics / team building / team skills	O	O	O	O	O

← →

Research on Hybrid Project Management

In which **industry** do you work?
(if multiple please indicate the one which represents your experiences best)

- Agriculture, Forestry and Fishing
- Mining
- Construction
- Manufacturing
- Transportation, Communications, Electric, Gas and Sanitary service
- Wholesale Trade
- Retail Trade
- Finance, Insurance and Real Estate
- Services
- Public Administration
- Other (please specifiy)

On what **type of project** do you work?
(if multiple please indicate the one which represents your experiences best)

- Research (e.g. market research)
- Organizational Change (e.g. Digital transformation, HR transformation)
- Hardware Development (Hardware) (e.g. mobile phone hardware development, development of a new construction machine)
- Software Development (Software) (e.g. mobile phone software development, development of a new excavator control unit)
- Product Development (product line) (e.g. new insurance product)
- Process Improvement (e.g. call center process improvement)
- Other (please specifiy)

What is your **role**?
(if multiple please indicate the one which represents your experiences best)

- Project Manager
- Project Coordinator / Project Assistant
- Project Member (programmer, business analyst, IT architect, organisational design specialist etc. please specify)
- Project Management Office (PMO)
- Scrum Master
- Product Owner
- Consultant (Methods / Organisational Change)
- Leadership / Management / Sponsor

How long is your project management experience?

	1-2 years	3-5 years	6-9 years	10-20 years	more than 20 years
Traditional Project Management	○	○	○	○	○
Agile Project Management	○	○	○	○	○

How large is your **project or project organization**?
(you have referenced to the questions above - if multiple please indicate the one which represents your experiences best)
see definition of FTE here

1-5 FTE (full time equivalent)

6-12 FTE (full time equivalent)

13 - 30 FTE (full time equivalent)

31 - 100 FTE (full time equivalent)

101 - 500 FTE (full time equivalent)

501 or more FTE (full time equivalent)

not sure

How large is your **company** or overall organization?

if your company belongs to a group of companies, please indicate the group size
(you have referenced to the questions above - if multiple please indicate the one which represents your experiences best)
see definition of FTE here

- 10 FTE (full time equivalent)
- 11-50 FTE (full time equivalent)
- 51 - 100 FTE (full time equivalent)
- 101 - 500 FTE (full time equivalent)
- 501 - 5000 FTE (full time equivalent)
- 5001 or more FTE (full time equivalent)
- not sure

In which country do you currently reside?

Germany ▼

← →

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May I contact you for sharing the results or to schedule an interview to deepen the study?
(this is entirely voluntary)

Yes

No

→

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Contact details to share research results and/ or contact for interview participation

First and Last Name	
E-mail address	
Telephone	

← →

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Do you have any other comment?

←

→

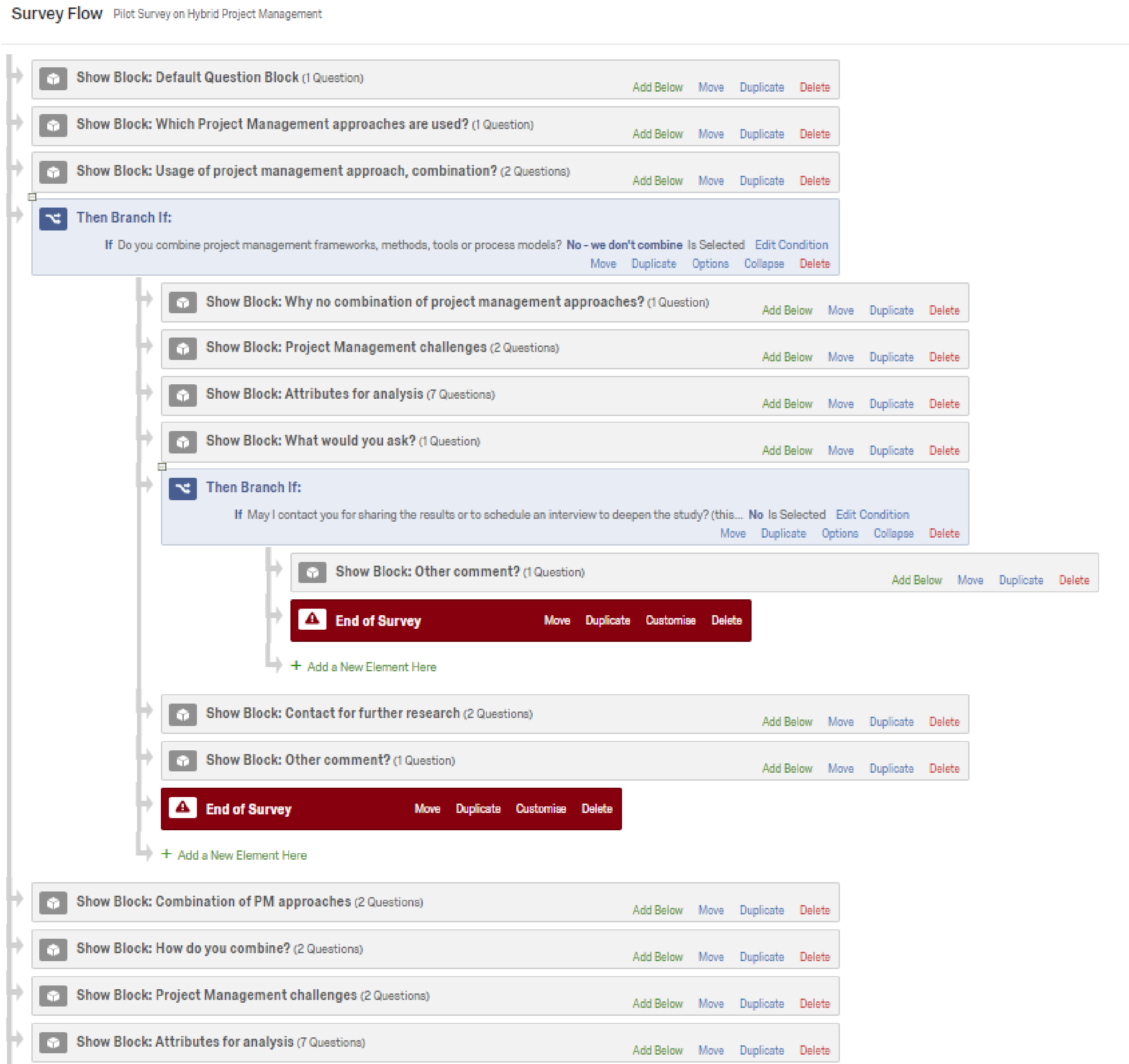
Research on Hybrid Project Management

Thank you for your participation!

If you would like to contact me please feel free to reach out to:

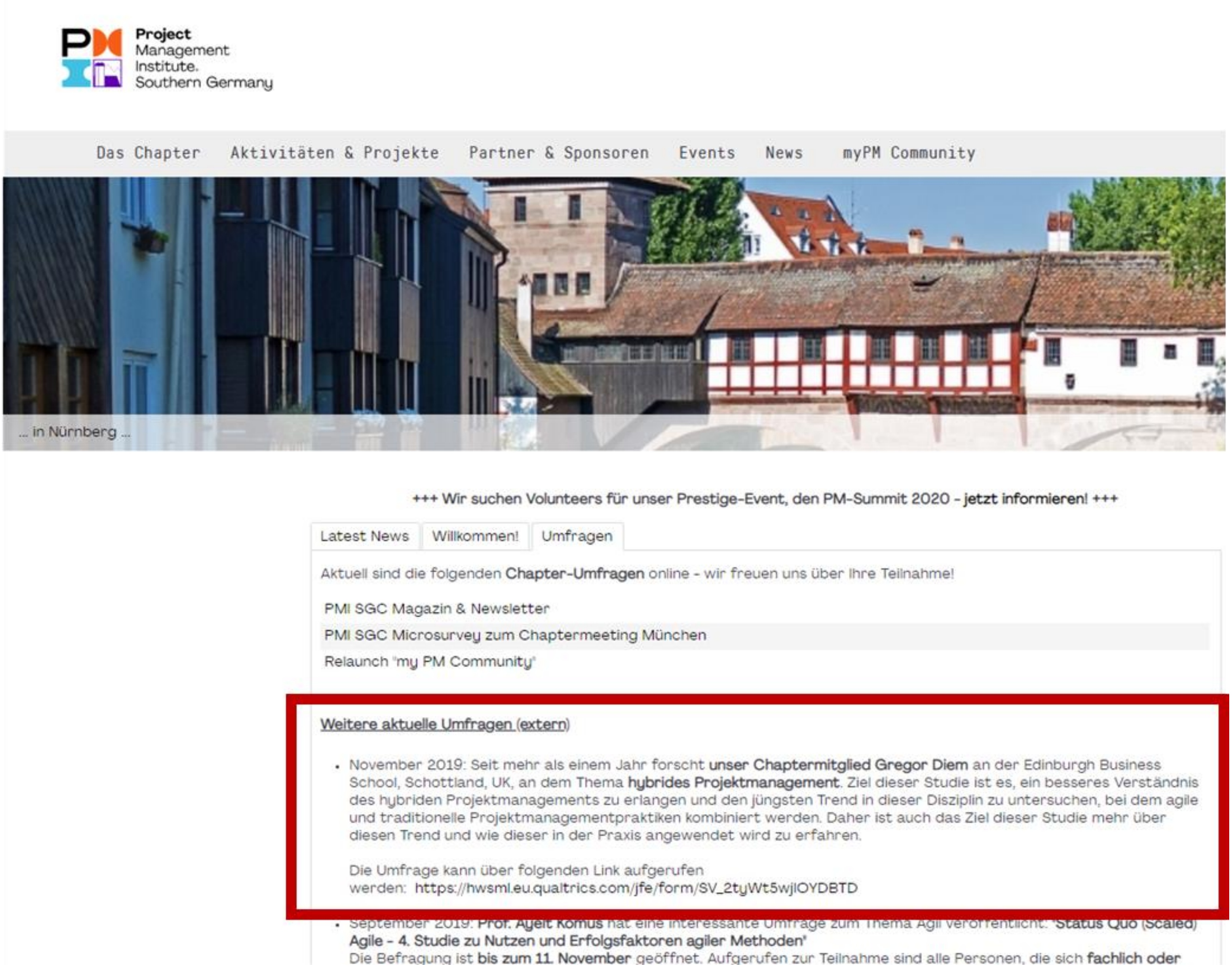
Name: Gregor Diem
E-mail: gd35@hw.ac.uk
Phone: +49 (0) 1577 1758100

Appendix 2: Survey Flow



Appendix 3: PMI Southern Germany Community

The survey has since November 2019 been on the PMI Southern Germany website:
https://www.pmi-sgc.de/#umfragen



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Relaunch "my PM Community"

Weitere aktuelle Umfragen (extern)

- November 2019: Seit mehr als einem Jahr forscht **unser Chaptermitglied Gregor Diem** an der Edinburgh Business School, Schottland, UK, an dem Thema **hybrides Projektmanagement**. Ziel dieser Studie ist es, ein besseres Verständnis des hybriden Projektmanagements zu erlangen und den jüngsten Trend in dieser Disziplin zu untersuchen, bei dem agile und traditionelle Projektmanagementpraktiken kombiniert werden. Daher ist auch das Ziel dieser Studie mehr über diesen Trend und wie dieser in der Praxis angewendet wird zu erfahren.

  Die Umfrage kann über folgenden Link aufgerufen werden: https://hwsml.eu.qualtrics.com/jfe/form/SV_2tyWt5wjlOYDBTD

- September 2019: **Prof. Ayelt Komus** hat eine interessante Umfrage zum Thema Agil veröffentlicht: "**Status Quo (Scaled) Agile - 4. Studie zu Nutzen und Erfolgsfaktoren agiler Methoden**"
  Die Befragung ist **bis zum 11. November** geöffnet. Aufgerufen zur Teilnahme sind alle Personen, die sich **fachlich oder**

Discusion held on Hybrid Project Management June 25th, 2020

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Beschreibung

Agenda:

18:00 Uhr – Begrüßung, Einleitung, Infos zum Ablauf

18:15 Uhr – Vortrag 1: -> „Office 365 – Professionelles Arbeiten im Homeoffice: Wie können die Office 365 und Edison 365 Apps ideal für das Arbeiten im Homeoffice genutzt werden? – Digitaler Arbeitsplatz der Zukunft in Corona Zeiten (Vortrag Herr Andreas Hock, Partner 3Pworx GmbH)

3PWORX

19:15 Uhr – Vortrag 2: „Erfolgreich handeln in der Corona Krise – Funktionierende Managementprinzipien (Vortrag von Herrn Prof. Dr. Komus)

20:15 Uhr – Vortrag 3: „Hybrides Projektmanagement – Vorstellung der Studienergebnisse (Vortrag von Herrn Gregor Diem)

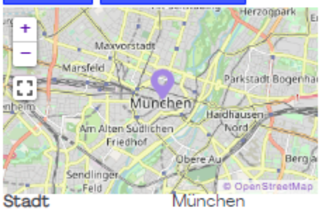
21:30 Uhr: Q&A

Ca. 22:00 Uhr – Ende des 3Pworx 3. Agilen Trendforums Juni 2020 digital

Standortinformationen

ONLINE | WEBINAR

KARTE   ROUTENPLANER



Stadt	München
Bundesland	Bayern
Land	Deutschland

Group discusion held on Hybrid Project Management July 8th, 2020

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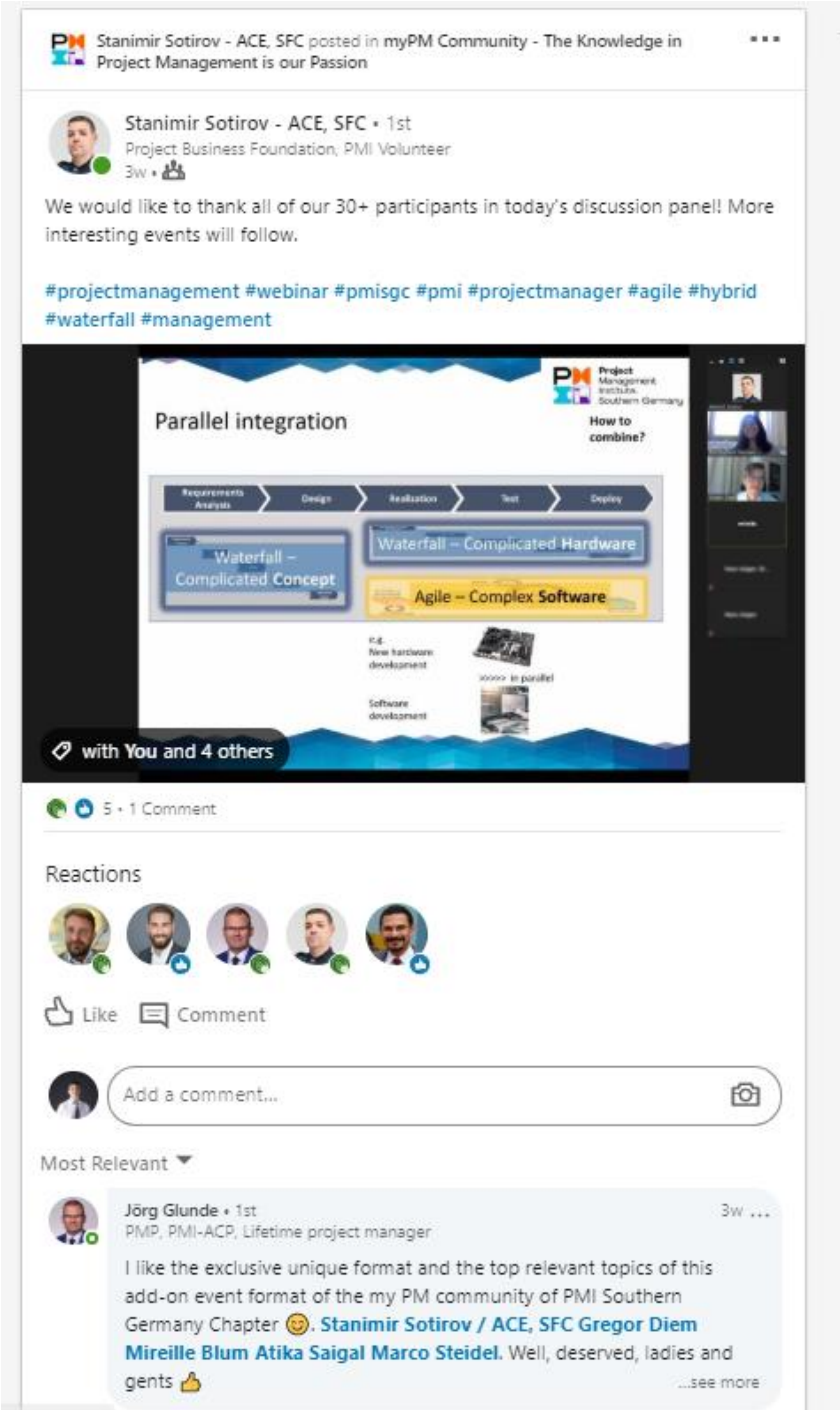

Appendix 4: Results of hypothesis testing

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Scope changes (SC)	277	2.10	.813	.049
Communication (CO)	277	2.42	.876	.053
Stakeholder support and engagement (SS)	277	2.74	.862	.052
Goals or requirements (GR)	273	2.63	.907	.055
Accountability (AC)	274	3.06	.918	.055
Clarity in organising change (OC)	276	3.15	.928	.056
Planning and deadlines (PD)	274	2.68	.906	.055
Clarity in expectation management and deliverables (EM)	273	2.99	.931	.056
Prioritizing of task and activities (PT)	273	2.93	.854	.052
Team dynamics/team building (TD)	275	3.41	1.058	.064
Determining which **solution fits in with the organisation** and its stakeholders (OS)	264	3.29	.964	.059
Risk management (RM)	271	3.27	.966	.059
Resource conflicts or deprivations (RC)	272	2.58	.938	.057
Understanding of complexity and interdependencies (CI)	274	2.65	.943	.057
Team skills (TS)	271	3.40	.837	.051

One-Sample Test						
	Test Value >= 4					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Scope changes (SC)	-38.954	276	**.000**	-1.903	-2.00	-1.81
Communication (CO)	-29.989	276	**.000**	-1.578	-1.68	-1.47
Stakeholder support and engagement (SS)	-24.314	276	**.000**	-1.260	-1.36	-1.16
Goals or requirements (GR)	-24.964	272	**.000**	-1.370	-1.48	-1.26
Accountability (AC)	-16.917	273	**.000**	-.938	-1.05	-.83
Clarity in organising change (OC)	-15.240	275	**.000**	-.851	-.96	-.74
Planning and deadlines (PD)	-24.205	273	**.000**	-1.325	-1.43	-1.22
Clarity in expectation management and deliverables (EM)	-17.869	272	**.000**	-1.007	-1.12	-.90
Prioritizing of task and activities (PT)	-20.756	272	**.000**	-1.073	-1.18	-.97
Team dynamics/team building (TD)	-9.176	274	**.000**	-.585	-.71	-.46
Determining which **solution fits in with the organisation** and its stakeholders (OS)	-11.936	263	**.000**	-.708	-.83	-.59
Risk management (RM)	-12.392	270	**.000**	-.727	-.84	-.61
Resource conflicts or deprivations (RC)	-25.019	271	**.000**	-1.423	-1.53	-1.31
Understanding of complexity and interdependencies (CI)	-23.773	273	**.000**	-1.354	-1.47	-1.24
Team skills (TS)	-11.836	270	**.000**	-.601	-.70	-.50

Appendix 5: Test of normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Scope changes (SC)	.288	245	.000	.840	245	.000
Communication (CO)	.237	245	.000	.883	245	.000
Stakeholder support and engagement (SS)	.229	245	.000	.882	245	.000
Goals or requirements (GR)	.239	245	.000	.882	245	.000
Accountability (AC)	.203	245	.000	.892	245	.000
Clarity in organising change (OC)	.211	245	.000	.882	245	.000
Planning and deadlines (PD)	.218	245	.000	.895	245	.000
Clarity in expectation management and deliverables (EM)	.194	245	.000	.888	245	.000
Prioritizing of task and activities (PT)	.234	245	.000	.883	245	.000
Team dynamics/team building (TD)	.260	245	.000	.886	245	.000
Determining which **solution fits in with the organisation** and its stakeholders (OS)	.223	245	.000	.897	245	.000
Risk management (RM)	.211	245	.000	.900	245	.000
Resource conflicts or deprivations (RC)	.218	245	.000	.894	245	.000
Understanding of complexity and interdependencies (CI)	.212	245	.000	.897	245	.000
Team skills (TS)	.269	245	.000	.842	245	.000

a. Lilliefors Significance Correction

Appendix 6: Mann–Whitney U Test of research question 3

Comparing traditional project management compared with agile project management:

a) Ranks

Ranks				
	PM Group	N	Mean Rank	Sum of Ranks
Scope changes (SC)	Traditionalist	115	89.95	10344.00
	Agilist	61	85.77	5232.00
	Total	176		
Communication (CO)	Traditionalist	115	84.33	9697.50
	Agilist	62	97.67	6055.50
	Total	177		
Stakeholder support and engagement (SS)	Traditionalist	115	83.14	9561.00
	Agilist	62	99.87	6192.00
	Total	177		
Goals or requirements (GR)	Traditionalist	114	87.65	9992.50
	Agilist	61	88.65	5407.50
	Total	175		
Accountability (AC)	Traditionalist	114	85.60	9758.50
	Agilist	62	93.83	5817.50
	Total	176		
Clarity in organising change (OC)	Traditionalist	114	83.93	9567.50
	Agilist	61	95.61	5832.50
	Total	175		
Planning and deadlines (PD)	Traditionalist	115	81.81	9408.50
	Agilist	60	99.86	5991.50
	Total	175		
Clarity in expectation management and deliverables (EM)	Traditionalist	114	83.96	9572.00
	Agilist	60	94.22	5653.00
	Total	174		
Prioritizing of task and activities (PT)	Traditionalist	115	82.17	9449.50
	Agilist	58	96.58	5601.50
	Total	173		

Team dynamics/team building (TD)	Traditionalist	115	86.03	9893.50
	Agilist	60	91.78	5506.50
	Total	175		
Determining which **solution fits in with the organisation** and its stakeholders (OS)	Traditionalist	109	78.40	8545.50
	Agilist	58	94.53	5482.50
	Total	167		
Risk management (RM)	Traditionalist	114	86.04	9808.00
	Agilist	59	88.86	5243.00
	Total	173		
Resource conflicts or deprivations (RC)	Traditionalist	113	80.19	9062.00
	Agilist	60	99.82	5989.00
	Total	173		
Understanding of complexity and interdependencies (CI)	Traditionalist	113	87.47	9884.00
	Agilist	61	87.56	5341.00
	Total	174		
Team skills (TS)	Traditionalist	114	83.60	9530.00
	Agilist	60	94.92	5695.00
	Total	174		

b) Test Statistics/Significance traditional project management compared with agile project management

Test Statistics[a]															
	Scope changes (SC)	**Communication (CO)**	**Stakeholder support and engagement (SS)**	**Goals or requirements (GR)**	**Accountability (AC)**	**Clarity in organising change (OC)**	**Planning and deadlines (PD)**	Clarity in expectation management (EM)	**Prioritizing of task and activities (PT)**	**Team dynamics/team building (TD)**	Determining which solution fits in with the organisation and its stakeholders (OS)	**Risk management (RM)**	**Resource conflicts or deprivations (RC)**	**Understanding of complexity and interdependencies (CI)**	**Team skills (TS)**
Mann-Whitney U	3341.0	3027.5	2891.0	3437.5	3203.5	3012.5	2738.5	3017.0	2779.5	3223.5	2550.5	3253.0	2621.0	3443.0	2975.0
Wilcoxon W	5232.0	9697.5	9561.0	9992.5	9758.5	9567.5	9408.5	9572.0	9449.5	9893.500	8545.500	9808.000	9062.000	9884.0	9530.0
Z	-.570	-1.754	-2.217	-.131	-1.079	-1.524	-2.369	-1.338	-1.907	-.756	-2.150	-.370	-2.615	-.012	-1.544
Asymp. Sig. (2-tailed)	**.569**	**.079**	**.027**	**.896**	**.281**	**.127**	**.018**	**.181**	**.056**	**.450**	**.032**	**.711**	**.009**	**.991**	**.123**

a. Grouping Variable: PM Group

Comparing hybrid project management compared with agile project management:

a) Ranks

Ranks				
	PM Group	N	Mean Rank	Sum of Ranks
Scope changes (SC)	Hybrid	101	84.60	8545.00
	Agilist	61	76.36	4658.00
	Total	162		
Communication (CO)	Hybrid	100	76.97	7696.50
	Agilist	62	88.81	5506.50
	Total	162		
Stakeholder support and engagement (SS)	Hybrid	100	75.36	7536.00
	Agilist	62	91.40	5667.00
	Total	162		
Goals or requirements (GR)	Hybrid	98	81.25	7962.50
	Agilist	61	77.99	4757.50
	Total	159		
Accountability (AC)	Hybrid	98	79.30	7771.00
	Agilist	62	82.40	5109.00
	Total	160		
Clarity in organising change (OC)	Hybrid	101	81.93	8274.50
	Agilist	61	80.80	4928.50
	Total	162		
Planning and deadlines (PD)	Hybrid	99	75.73	7497.00
	Agilist	60	87.05	5223.00
	Total	159		
Clarity in expectation management and deliverables (EM)	Hybrid	99	81.54	8072.00
	Agilist	60	77.47	4648.00
	Total	159		
Prioritizing of task and activities (PT)	Hybrid	100	75.39	7538.50
	Agilist	58	86.59	5022.50
	Total	158		
Team dynamics/team building (TD)	Hybrid	100	74.07	7407.00
	Agilist	60	91.22	5473.00
	Total	160		
Determining which **solution fits in with the**	Hybrid	97	73.57	7136.00
	Agilist	58	85.41	4954.00
	Total	155		

organisation and its stakeholders (OS)				
Risk management (RM)	Hybrid	98	77.38	7583.50
	Agilist	59	81.69	4819.50
	Total	157		
Resource conflicts or deprivations (RC)	Hybrid	99	69.58	6888.00
	Agilist	60	97.20	5832.00
	Total	159		
Understanding of complexity and interdependencies (CI)	Hybrid	100	81.13	8113.00
	Agilist	61	80.79	4928.00
	Total	161		
Team skills (TS)	Hybrid	97	73.16	7096.50
	Agilist	60	88.44	5306.50
	Total	157		

b) Test Statistics/traditional project management compared with agile project management

Test Statistics[a]															
	Scope changes (SC)	**Communication (CO)**	**Stakeholder support and engagement (SS)**	**Goals or requirements (GR)**	**Accountability (AC)**	**Clarity in organising change (OC)**	**Planning and deadlines (PD)**	Clarity in expectation management (EM)	**Prioritizing of task and activities (PT)**	**Team dynamics/team building (TD)**	Determining which solution fits in with the organisation and its stakeholders (OS)	**Risk management (RM)**	**Resource conflicts or deprivations (RC)**	**Understanding of complexity and interdependencies (CT)**	**Team skills (TS)**
Mann-Whitney U	2767.0	2646.5	2486.0	2866.5	2920.0	3037.5	2547.0	2818.0	2488.5	2357.0	2383.00	2732.50	1938.00	3037.0	2343.5
Wilcoxon W	4658.0	7696.5	7536.0	4757.5	7771.0	4928.50	7497.0	4648.0	7538.5	7407.0	7136.0	7583.5	6888.0	4928.0	7096.5
Z	-1.178	-1.673	-2.281	-.455	-.439	-.157	-1.606	-.568	-1.584	-2.368	-1.688	-.602	-3.885	-.048	-2.207
Asymp. Sig. (2-tailed)	**.239**	**.094**	**.023**	**.649**	**.661**	**.875**	**.108**	**.570**	**.113**	**.018**	**.091**	**.547**	**.000**	**.962**	**.027**
a. Grouping Variable: PM Group															

Comparing Traditional project management compare with hybrid project management:

a) Ranks

Ranks				
	PM Group	N	Mean Rank	Sum of Ranks
Scope changes (SC)	Traditionalist	115	105.72	12158.00
	Hybrid	101	111.66	11278.00
	Total	216		
Communication (CO)	Traditionalist	115	107.46	12358.00
	Hybrid	100	108.62	10862.00
	Total	215		
Stakeholder support and engagement (SS)	Traditionalist	115	108.21	12444.00
	Hybrid	100	107.76	10776.00
	Total	215		
Goals or requirements (GR)	Traditionalist	114	103.68	11820.00
	Hybrid	98	109.78	10758.00
	Total	212		
Accountability (AC)	Traditionalist	114	103.85	11839.00
	Hybrid	98	109.58	10739.00
	Total	212		
Clarity in organising change (OC)	Traditionalist	114	101.08	11523.00
	Hybrid	101	115.81	11697.00
	Total	215		
Planning and deadlines (PD)	Traditionalist	115	104.10	11972.00
	Hybrid	99	111.44	11033.00
	Total	214		
Clarity in expectation management and deliverables (EM)	Traditionalist	114	98.28	11203.50
	Hybrid	99	117.05	11587.50
	Total	213		
Prioritizing of task and activities (PT)	Traditionalist	115	106.73	12274.50
	Hybrid	100	109.46	10945.50
	Total	215		
Team dynamics/team building (TD)	Traditionalist	115	115.25	13254.00
	Hybrid	100	99.66	9966.00
	Total	215		
Determining which **solution fits in with the**	Traditionalist	109	100.85	10992.50
	Hybrid	97	106.48	10328.50
	Total	206		

organisation and its stakeholders (OS)				
Risk management (RM)	Traditionalist	114	107.54	12260.00
	Hybrid	98	105.29	10318.00
	Total	212		
Resource conflicts or deprivations (RC)	Traditionalist	113	111.24	12570.00
	Hybrid	99	101.09	10008.00
	Total	212		
Understanding of complexity and interdependencies (CI)	Traditionalist	113	106.82	12071.00
	Hybrid	100	107.20	10720.00
	Total	213		
Team skills (TS)	Traditionalist	114	109.22	12451.00
	Hybrid	97	102.22	9915.00
	Total	211		

b) Test Statistics/Traditional project management compared with hybrid project management

Test Statistics[a]

	Scope changes (SC)	Communication (CO)	Stakeholder support and engagement (SS)	Goals or requirements (GR)	Accountability (AC)	Clarity in organising change (OC)	Planning and deadlines (PD)	Clarity in expectation management (EM)	Prioritizing of task and activities (PT)	Team dynamics/team building (TD)	Determining which solution fits in with the organisation and its stakeholders (OS)	Risk management (RM)	Resource conflicts or deprivations (RC)	Understanding of complexity and interdependencies (CI)	Team skills (TS)
Mann-Whitney U	5488.0	5688.0	5726.0	5265.0	5284.0	4968.0	5302.0	4648.50	5604.5	4916.0	4997.5	5467.0	5058.0	5630.0	5162.0
Wilcoxon W	12158.0	12358.0	10776.0	11820.0	11839.0	11523.0	11972.0	11203.50	12274.5	9966.0	10992.5	10318.0	10008.0	12071.0	9915.0
Z	-.754	-.145	-.056	-.762	-.713	-1.818	-.914	-2.331	-.341	-1.915	-.710	-.280	-1.259	-.047	-.895
Asymp. Sig. (2-tailed)	.451	.885	.955	.446	.476	.069	.361	.020	.733	.056	.477	.779	.208	.960	.371

a. Grouping Variable: PM Group

Appendix 7: Cronbach's alpha results of data for project management factors

Case Processing Summary

		N	%
Cases	Valid	272	97.5
	Excluded[a]	7	2.5
	Total	279	100.0

a. Listwise deletion based on all the variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.809	0.812	15

Item Statistics

	Mean	Std. Deviation	N
Scope changes (SC)	2.11	.883	272
Communication (CO)	2.42	.873	272
Stakeholder support and engagement (SS)	2.74	.870	272
Goals or requirements (GR)	2.69	1.110	272
Accountability (AC)	3.06	.919	272
Clarity in organising change (OC)	3.15	.929	272
Planning and deadlines (PD)	2.68	.908	272
Clarity in expectation management and deliverables (EM)	3.07	1.105	272
Prioritizing of task and activities (PT)	2.99	1.002	272
Team dynamics/team building (TD)	3.46	1.123	272
Determining which solution fits in with the organisation and its stakeholders (OS)	3.50	1.356	272
Risk management (RM)	3.37	1.148	272
Resource conflicts or deprivations (RC)	2.61	1.046	272
Understanding of complexity (CI)	2.68	1.043	272
Team skills (TS)	3.47	.990	272

Appendix 8: Correlation Matrices for Traditional, Agile and Hybrid project management

Correlation Matrix for Traditionalist PM Group

Correlation Matrix[a]

		Scope changes (SC)	Communication (CO)	Stakeholder support and engagement (SS)	Goals or requirements (GR)	Accountability (AC)	Clarity on how to organize the change (OC)	Planning deadlines (PD)	Expectation management (EM)	Inadequate prioritizing (PT)	Team dynamics (TD)	Solution fit (OS)	Risk management RM	Resource conflicts or deprivation (RC)	Complexity (CI)	Team skills (TS)
Correlation	Scope changes (SC)	1.000	.399	.482	.318	.205	.400	.116	.199	.245	.305	.260	.116	-.009	.200	.198
	Communication (CO)	.399	1.000	.579	.318	.460	.494	.309	.247	.574	.365	.260	.293	.170	.327	.339
	Stakeholder support and engagement (SS)	.482	.579	1.000	.361	.488	.473	.274	.314	.428	.490	.547	.233	.113	.294	.346
	Goals or requirements (GR)	.318	.318	.361	1.000	.344	.432	.242	.454	.500	.274	.368	.259	.237	.196	.232
	Accountability (AC)	.205	.460	.488	.344	1.000	.376	.220	.269	.386	.313	.524	.279	.170	.168	.387
	Clarity on how to organize the change (OC)	.400	.494	.473	.432	.376	1.000	.256	.357	.445	.363	.507	.338	.184	.438	.256
	Planning deadlines (PD)	.116	.309	.274	.242	.220	.256	1.000	.441	.296	.320	.256	.206	.221	.390	.193
	Clarity on expectation management (EM)	.199	.247	.314	.454	.269	.357	.441	1.000	.354	.389	.487	.234	.206	.379	.257
	Inadequate prioritizing (PT)	.245	.574	.428	.500	.386	.445	.296	.354	1.000	.418	.312	.326	.198	.366	.262
	Team dynamics (TD)	.305	.365	.490	.274	.313	.363	.320	.389	.418	1.000	.578	.256	.167	.447	.355
	Solution fit (OS)	.260	.260	.547	.368	.524	.507	.256	.487	.312	.578	1.000	.345	.180	.447	.397
	Risk management (RM)	.116	.293	.233	.259	.279	.338	.206	.234	.326	.256	.345	1.000	.393	.475	.226
	Resource conflicts or deprivation (RC)	-.009	.170	.113	.237	.170	.184	.221	.206	.198	.167	.180	.393	1.000	.211	.320
	Complexity (CI)	.200	.327	.294	.196	.168	.438	.390	.379	.366	.447	.447	.475	.211	1.000	.288
	Team skills (TS)	.198	.339	.346	.232	.387	.256	.193	.257	.262	.355	.397	.226	.320	.288	1.000

a. Only cases for which PM Group = Traditionalist are used in the analysis phase.

KMO and Bartlett's Test for Traditionalist PM Group

KMO and Bartlett's Test[a]		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.849
Bartlett's Test of Sphericity	Approx. Chi-Square	567.325
	df	105
	Sig.	.000

a. Only cases for which PM Group = Traditionalist are used in the analysis phase.

Correlation Matrix for Agilist PM Group

Correlation Matrix[a]

		Scope changes (SC)	Communication (CO)	Stakeholder support and engagement (SS)	Goals or requirements (GR)	Accountability (AC)	Clarity on how to organize the change (OC)	Planning deadlines (PD)	Expectation management (EM)	Inadequate prioritizing (PT)	Team dynamics (TD)	Solution fit (OS)	Risk management RM	Resource conflicts or deprivation (RC)	Complexity (CI)	Team skills (TS)
Correlation	Scope changes (SC)	1.000	.249	.186	.412	.195	.223	.032	.198	.214	.138	.070	.047	.005	.105	-.022
	Communication (CO)	.249	1.000	.490	.263	.381	.433	.141	.355	.185	.251	.198	.174	.300	.303	.133
	Stakeholder support and engagement (SS)	.186	.490	1.000	.333	.360	.450	.264	.306	.182	.031	.278	.146	.334	.322	.114
	Goals or requirements (GR)	.412	.263	.333	1.000	.310	.534	.112	.541	.328	.250	.459	.438	.128	.546	.272
	Accountability (AC)	.195	.381	.360	.310	1.000	.490	.397	.415	.448	.285	.327	.430	.096	.415	.127
	Clarity on how to organize the change (OC)	.223	.433	.450	.534	.490	1.000	.492	.553	.360	.193	.436	.423	.217	.525	.262
	Planning deadlines (PD)	.032	.141	.264	.112	.397	.492	1.000	.453	.368	.100	.328	.362	.221	.338	.104
	Clarity on expectation management (EM)	.198	.355	.306	.541	.415	.553	.453	1.000	.262	.229	.495	.424	.189	.429	.275
	Inadequate prioritizing (PT)	.214	.185	.182	.328	.448	.360	.368	.262	1.000	.160	.405	.283	.263	.288	.166
	Team dynamics (TD)	.138	.251	.031	.250	.285	.193	.100	.229	.160	1.000	.446	.282	.001	.301	.175
	Solution fit (OS)	.070	.198	.278	.459	.327	.436	.328	.495	.405	.446	1.000	.481	.372	.521	.420
	Risk management (RM)	.047	.174	.146	.438	.430	.423	.362	.424	.283	.282	.481	1.000	.011	.453	.397
	Resource conflicts or deprivation (RC)	.005	.300	.334	.128	.096	.217	.221	.189	.263	.001	.372	.011	1.000	.445	.198
	Complexity (CI)	.105	.303	.322	.546	.415	.525	.338	.429	.288	.301	.521	.453	.445	1.000	.360
	Team skills (TS)	-.022	.133	.114	.272	.127	.262	.104	.275	.166	.175	.420	.397	.198	.360	1.000

a. Only cases for which PM Group = Agilist are used in the analysis phase.

KMO and Bartlett's Test for Agilist PM Group

KMO and Bartlett's Test[a]		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.773
Bartlett's Test of Sphericity	Approx. Chi-Square	279.200
	df	105
	Sig.	.000

a. Only cases for which PM Group = Agilist are used in the analysis phase.

Correlation Matrix for Hybrid PM Group

Correlation Matrix[a]

		Scope changes (SC)	Communication (CO)	Stakeholder support and engagement (SS)	Goals or requirements (GR)	Accountability (AC)	Clarity on how to organize the change (OC)	Planning deadlines (PD)	Expectation management (EM)	Inadequate prioritizing (PT)	Team dynamics (TD)	Solution fit (OS)	Risk management RM	Resource conflicts or deprivation (RC)	Complexity (CI)	Team skills (TS)
Correlation	Scope changes (SC)	1.000	.291	.062	.200	.267	.153	.232	.023	.031	.082	.123	.089	.122	-.005	.063
	Communication (CO)	.291	1.000	.332	.225	.369	.074	.009	.125	-.019	.198	.101	.160	.208	.211	.166
	Stakeholder support and engagement (SS)	.062	.332	1.000	.360	.251	.003	.104	.098	.159	-.020	-.089	.279	.244	.234	.007
	Goals or requirements (GR)	.200	.225	.360	1.000	.371	.121	.091	.275	.276	.067	.036	.257	.148	.358	.115
	Accountability (AC)	.267	.369	.251	.371	1.000	.144	.174	.112	.074	.116	.021	.258	.095	.116	.235
	Clarity on how to organize the change (OC)	.153	.074	.003	.121	.144	1.000	.284	.292	.245	-.218	.188	.321	.054	.199	.117
	Planning deadlines (PD)	.232	.009	.104	.091	.174	.284	1.000	.247	.176	.151	.271	.452	.253	.065	.155
	Clarity on expectation management (EM)	.023	.125	.098	.275	.112	.292	.247	1.000	.197	.083	.166	.159	-.080	.246	.082
	Inadequate prioritizing (PT)	.031	-.019	.159	.276	.074	.245	.176	.197	1.000	-.007	-.039	.222	.306	.246	-.005
	Team dynamics (TD)	.082	.198	-.020	.067	.116	-.218	.151	.083	-.007	1.000	.386	.137	.158	-.012	.329
	Solution fit (OS)	.123	.101	-.089	.036	.021	.188	.271	.166	-.039	.386	1.000	.243	.079	.287	.401
	Risk management (RM)	.089	.160	.279	.257	.258	.321	.452	.159	.222	.137	.243	1.000	.260	.266	.174
	Resource conflicts or deprivation (RC)	.122	.208	.244	.148	.095	.054	.253	-.080	.306	.158	.079	.260	1.000	.353	.181
	Complexity (CI)	-.005	.211	.234	.358	.116	.199	.065	.246	.246	-.012	.287	.266	.353	1.000	.108
	Team skills (TS)	.063	.166	.007	.115	.235	.117	.155	.082	-.005	.329	.401	.174	.181	.108	1.000

a. Only cases for which PM Group = Hybrid are used in the analysis phase.

KMO and Bartlett's Test for Hybrid PM Group

KMO and Bartlett's Test[a]		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.640
Bartlett's Test of Sphericity	Approx. Chi-Square	264.719
	df	105
	Sig.	.000

a. Only cases for which PM Group = Hybrid are used in the analysis phase.