



Hybrid project management – a systematic literature review

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Abstract:

Hybrid project management is an approach that combines traditional and agile project management techniques. The goal is to benefit from the strengths of each approach, and, at the same time avoid the weaknesses. However, due to the variety of hybrid methodologies that have been presented in the meantime, it is not easy to understand the differences or similarities of the methodologies, as well as, the advantages or disadvantages of the hybrid approach in general. Additionally, there is only fragmented knowledge about prerequisites and success factors for successfully implementing hybrid project management in organizations. Hence, the aim of this study is to provide a structured overview of the current state of research regarding the topic. To address this aim, we have conducted a systematic literature review focusing on a set of specific research questions. As a result, four different hybrid methodologies are discussed, as well as, the definition, benefits, challenges, suitability and prerequisites of hybrid project management. Our study contributes to knowledge by synthesizing and structuring prior work in this growing area of research, which serves as a basis for purposeful and targeted research in the future.

Keywords:

hybrid project management; agile project management; traditional project management; project approaches; project management methodologies.

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1. Introduction

A main distinguishing feature of project management approaches is the division between traditional and agile project management, which differ fundamentally in their structures and processes. Due to continued dissatisfaction with the traditional plan-driven (heavyweight) approach, various agile (lightweight) methodologies have been introduced in recent years [1], including Scrum, Kanban, eXtreme Programming (XP) and others [2, 3].

The term project management *approach* is the “highest level of abstraction used when describing how a project will be designed” [4], whereas a project management *methodology* is more granular and provides specific guidance about how to manage a project [4, 5]. In this paper, we use the term approach to distinguish between traditional, agile and hybrid project management, whereas methodology refers to specific models such as Waterfall or Scrum. The terms methods or practices refer to individual tools or techniques that are used within a methodology, such as individual planning methods or specific types of meetings. However, in the literature, there is no uniform use or definition of these terms.

In the traditional project management approach, the project scope, time, and cost are determined in the early phases of the life cycle. Any changes to the scope are carefully managed [6]. One of the key characteristics of traditional project management is that it seeks to minimize changes during the course of the project through requirements gathering, analysis, and design up front to achieve higher quality results [7].

Agile project management has increasingly grown in popularity in recent years, especially driven by the release of the Manifesto for Agile Software Development at the beginning of the 21st century [8–10]. Agile project management attempts to make project execution flexible to changes in the environment and scope of services. Agile requirements tend to be primarily functional and reasonably informal [11]. This is mainly done with the help of short, sequential planning and execution cycles [12, 13], with the aim of providing autonomous project teams, frequent and honest feedback from clients and other stakeholders, as well as, flexibility of the project scope [14]. To complete projects, the agile project management focuses on incremental, iterative development cycles [15]. The agile project management approach is favored in many companies, especially in the IT sector. Agile methodologies are newer and come from software development [16]. The main advantage of all these methodologies is their flexibility [5, 17–19]. The agile approach is ideal for short-time project initiatives that need requirements to be discovered and new technology to be evaluated [20]. On small, stand-alone projects, agile methodologies are less burdensome and more in tune with the software industry’s increasing needs for rapid development and coping with continuous change [11].

Despite these advantages, the agile approach has increasingly been criticized in recent years. To make the development process faster, the agile approach enables the software development teams to focus on the final product rather than design and documentation [21, 22]. That can lead to the project documentation being neglected, since the development of the solution can be very time-consuming, and the project documentation is often of lower priority [23]. Another disadvantage of the agile approach can be a certain inaccuracy in time planning and budget scheduling, as the overall overview of the project can become confusing due to the constant re-prioritization of tasks [14, 24]. Moreover, there are numerous barriers and challenges that inhibit the realization of the agile benefits in an organizational context [10, 25]. Especially in large-scale transformation projects, basic agile principles such as team autonomy are hard to maintain [26].

As both, the traditional and agile project management approach have their advantages and disadvantages [5, 7], the hybrid approach has emerged that combines traditional and agile project management methodologies [1, 2, 4–6, 6, 15, 16, 18, 20, 27–29]. The aim of the hybrid project management approach is to bring together the best of the agile and traditional approaches [8, 27]. This is supposed to lead to achieving flexibility without unsettling project planning and to avoid the disadvantages of one approach with the help of positive elements from the opposite approach [19]. There are different methodologies such as the Water-Scrum-Fall model [9], the hybrid V-model [30], the Waterfall-Agile model [15], or the Agile-Stage-Gate model [13, 16]. Due to the variety and heterogeneity of hybrid methodologies that have been presented in the meantime, it is not easy to understand the differences or similarities of the methodologies, as well as, the advantages or disadvantages of the hybrid approach in general. Additionally, there is only fragmented

knowledge about the suitability of the hybrid approach depending on firm and project characteristics, as well as, about prerequisites and success factors for successfully implementing hybrid project management in organizations.

Hence, the aim of this study was to provide a structured overview of the current state of research regarding the topic of hybrid project management. To address this aim, we have conducted a systematic literature review (SLR) [31], focusing on a set of specific, pre-determined research questions that are outlined in the research design section of this paper.

In related studies, SLR on hybrid project management were previously conducted as well [32–34]. Calavieri Barbosa et al. [32] develop a hybrid “stage-gate – agile – design thinking” project management model taking into account the results from an SLR. However, due to their focus on the stage-gate methodology, the search is comparably narrow and not suitable for our purpose of providing an overview of the entire field of hybrid project management. Heimicke et al. [34] also focus on a particular context, namely product development. Papadakis and Tsironis [33] have conducted a SLR on hybrid project management in general. However, they define “hybrids” as a combination of “multiple methods, between agile methods or agile and plan-driven” [35]. According to our understanding, the term hybrid means combining the traditional and agile approach, which excludes tailored agile methods that do not integrate traditional, plan-driven elements. Due to these different definitions and aims, our results are not directly comparable.

Our study contributes to knowledge by synthesizing and structuring prior work in this growing area of research, which is a prerequisite of purposeful and targeted research in the future. Moreover, our research helps researchers to use consistent terminology and definitions in future studies. Finally, our research serves to identify important research gap that should be filled by future work.

The rest of the paper is organized as follows. Section 2 explains details of our research design. Subsequently, section 3 outlines the key findings from the literature review, reported along our research questions. After a discussion of the results in section 4, we finally conclude by summarizing our research, as well as, discussing implications, limitations and future research opportunities.

2. Research design

To search and analyze existing literature on hybrid project management, a systematic literature review (SLR) was conducted. Literature reviews are a central part of scientific work and SLR is an established method in the information systems and project management discipline (e.g., [36–38]). A SLR includes a systematic, explicit and reproducible review and analysis of all thematically relevant sources. The available knowledge from the sources is collected, analyzed and critically reviewed [31, 39].

For this research, the Web of Science (WoS) Core Collection database was searched to collect the literature, which is one of the leading bibliometric databases and has a wide coverage of peer-reviewed articles from various publishers and organizations [40], including for instance IEEE, Emerald and Springer. Following Webster and Watson’s suggestions that “the major contributions are likely to be in the leading journals” [31], we have deliberately restricted our initial search to the WoS database which has a high quality standard.

In our initial search, suitable literature was identified using a search string. The search string was structured in such way that literature explicitly mentioning the term “hybrid”, as well as literature describing a combination of agile and traditional project management was found (Table 1).

Table 1. Search string

Search string
(TS = (hybrid) OR (TS = (traditional) AND TS = (agile))) AND (TS = ("project management") OR TS = ("project approach"))

The search and selection of literature took place in several steps. Firstly, the search with the search string yielded 474 relevant papers (Figure 1). After applying a filter that limited the results to English-language results, 453 papers were left. Of the 453 papers, 4 were duplicates, so 449 papers remained. After analyzing the title and the abstract, 45 of the 449 papers were shortlisted. Of these, 28 were assigned to the category “suitable” and 14 to the category “unsure”. The articles classified as category “suitable” were clearly about hybrid project management, noted in the title, keywords and abstract, and the main theme of the article was relevant for our research questions. Articles classified as category “unsure” were those where the main theme of the article was not about hybrid project management, but according to the first screening the article might have contained some details or short paragraphs about hybrid project management. The next step was to analyze the full text of the suitable and unsure papers.

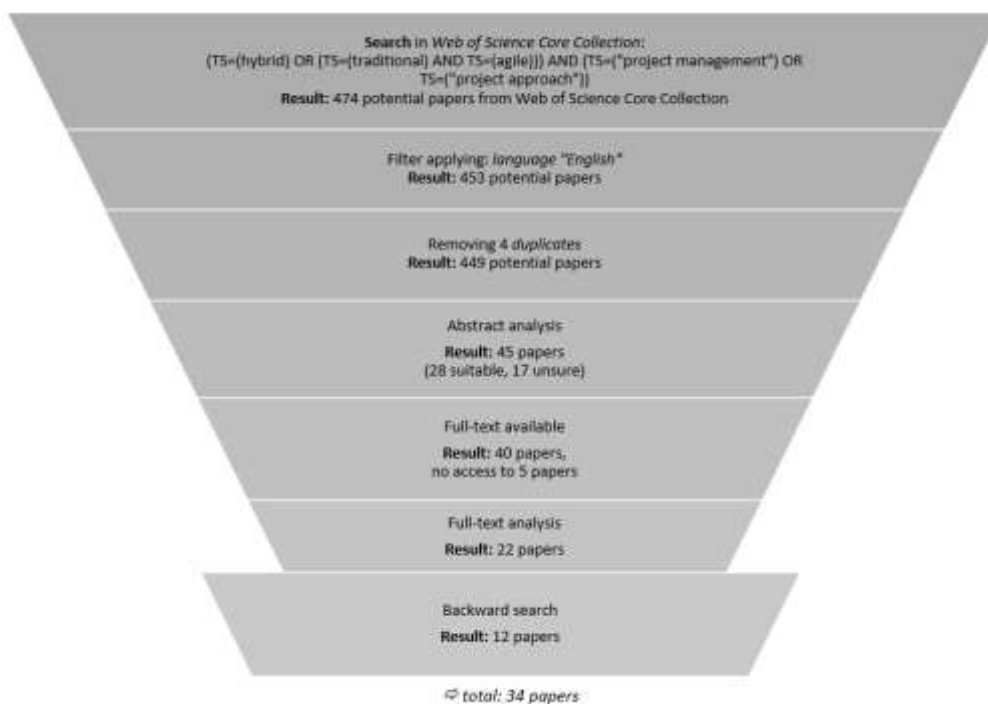


Fig. 1 Systematic literature review

During the analysis of the full texts, the selection of papers was limited to 22 pieces. In the second iteration, backward searching was performed to increase the coverage of the literature and to extend the scope of the literature to include papers that were cited by articles from the first iteration. Through the backward search, 12 articles were added to the literature collection. The final sample of the systematic literature analysis was therefore 22 papers plus 12 papers from the backward search, totaling in 34 papers [1–9, 11–22, 27–30, 32, 41–48].

The selection and analysis of articles was guided by six pre-determined research questions that can be found in Table 2. During the search and analysis of the literature, the individual papers were manually searched for relevant content related to the research questions. The literature was then systematically categorized with regard to the research questions using a spreadsheet to track the selection process and facilitate the subsequent detailed comparison and discussion.

Table 2. Research questions

Research questions	
RQ1:	What is the definition of hybrid project management?
RQ2:	How can traditional and agile methodologies be combined into a hybrid methodology?
RQ3:	What are the advantages and benefits of hybrid project management?
RQ4:	What are the disadvantages and challenges of hybrid project management?
RQ5:	What type of projects or firms is hybrid project management suitable for?
RQ6:	What prerequisites or success factors should be considered to successfully implement hybrid project management?

3. Key findings

3.1 Definition of hybrid project management

When analyzing the literature, it was noticeable that there are two different streams regarding how hybrid project management is defined. 20 out of 34 papers mention a *combination/mix of agile and traditional project management methodologies* [1, 2, 4–6, 9, 15–18, 20, 21, 27–30, 41, 45–47]. By combining an agile approach at the operational level and a traditional approach at the decision-making level, hybrid project management attempts to combine the advantages of both management systems [27].

In contrast, the remaining 14 papers describe hybrid project management as resulting from an *integration of an agile approach into existing traditional project management methodologies* [3, 7, 8, 11–14, 19, 22, 32, 42, 42–44, 48]. Organizations bring together their traditional approach with components of the agile approach for individual parts of the projects. In this way, the project management approach can be individually adapted to the needs, using the best aspects from both worlds [8].

3.2 Hybrid combinations

Based on the analysis of the papers, four different hybrid methodologies could be identified which systematically combine traditional and agile project management phases. In order to systematically compare these methodologies, we have summarized the methodologies in a uniform structure consisting of three generic project phases (Table 3). Besides these systematic methodologies, companies often combine individual methods and practices from the different methodologies. Often times, heavy-weight elements are combined with light-weighted agile elements. If a company applies hybrid project management, then the traditional approach is often supplemented by the agile approach in practice. Individual tasks of a project are then carried out agilely according to Scrum, for example, as firms are “cherry-picking” agile practices into their project management style [30]. Such methodologies are also systematically developed in research projects [6].

Table 3. Hybrid methodologies

Approach	Reference	Phases		
		Initial phase	Development phase	Final phase
Water-Scrum-Fall	[9], [29]	Waterfall - Requirements analysis - Planning	Scrum - Design - Development - Implementation	Waterfall - Integration - Testing

Approach	Reference	Phases		
		Initial phase	Development phase	Final phase
Waterfall-Agile	[15]	Waterfall - Requirements analysis - Planning	Agile approach - Design - Development - Implementation	Agile approach - Testing
Hybrid V-model	[30]	V-model - User requirements - System requirements - Planning	Scrum - Design - Implementation - Unit testing	V-model - Integration - System testing
Agile-Stage-Gate (Scrum-Stage-Gate)	[2], [13], [16], [22], [48]	Stage-Gate for administrative and strategic activities Scrum for operative activities - Discovery - Idea generation - Scoping	Stage-Gate for administrative and strategic activities Scrum for operative activities - Development - Implementation	Stage-Gate for administrative and strategic activities Scrum for operative activities - Testing - Validation - Launch

Water-Scrum-Fall

The Water-Scrum-Fall (Figure 2) methodology by West [9] combines the traditional Waterfall methodology with agile Scrum. It is based on the view that there must be a structural framework for a project which is provided with the established Waterfall methodology. Within this traditional process approach, agile phases are integrated. The complex part of the project, the development, is done based on the Scrum methodology [9].

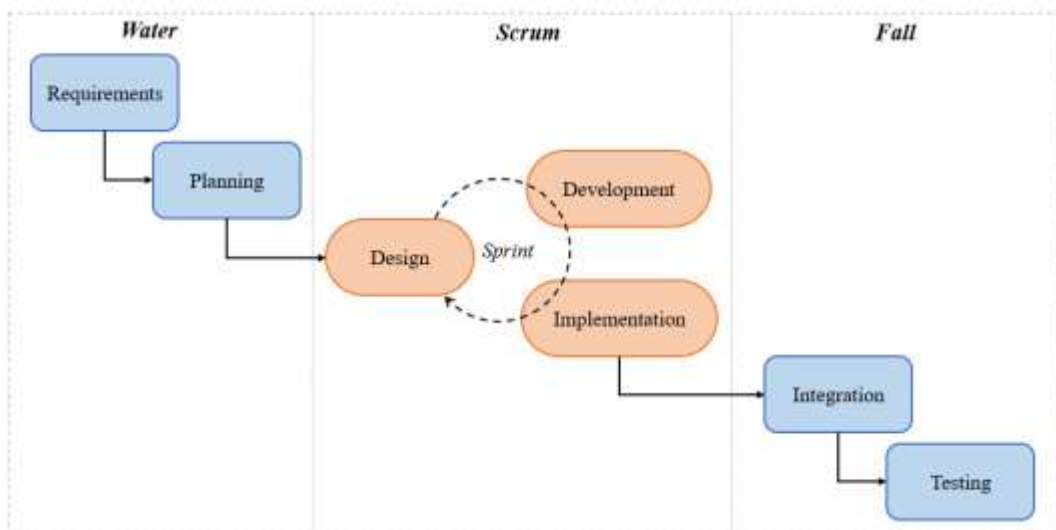


Fig. 2. Water-Scrum-Fall diagram. Source: adapted from [29]

The Waterfall methodology is the best known and simplest process model of traditional project management and operates in a sequential manner [15, 22, 27]. The individual project phases are completed one by one [15]. In order to get to the finished product at the end, each phase must be completed before moving onto the next [9]. It is also feasible to return to a previously completed phase if adjustments or corrections are required.

Scrum is one of the best known and most popular agile methodologies. Many Scrum aspects are common to agile methodologies, such as iterations, incremental development, self-managed teams, and flexibility in the face of changing requirements [3]. The term "iterative approach" refers to the division of the project duration into iterations or sprints, where the overall project is divided into several small projects [7]. Each sprint is structured in the same way: At the beginning of the sprint, the team decides which features will be developed during the sprint, team members then work on those features, and at the end of the sprint, the team meets with the customer to review and receive feedback on the features developed during the sprint [3]. The customer actively participates in the development process and can influence the course of the project throughout its duration. Sprints are usually two to four weeks long [48]. Each sprint is based on a sprint backlog, which describes a set of priority features (or product increments) to be developed in the current sprint, selected because they are high priority and can be completed within the specified timeframe of the sprint. While a sprint is running, the sprint backlog must not be changed [48]. Scrum is adaptive because it allows the team to respond to constantly changing requirements, market situations, changes in the project team, and other factors. Changing the project plan and scope does not require renegotiation of the contract; the changes are continuously adjusted.

In the initial phase of the Water-Scrum-Fall methodology, an upstream project planning phase takes place in which the agile realization is prepared and plans for time, budget and scope management are set up [29]. In addition, user requirements and system requirements are created in this phase. The upstream Waterfall phase makes it possible to minimize initial doubts, as initial documentation is created, and an initial contractual commitment is made [9]. The development is done according to agile methodologies in the second phase. Implementation takes place in iterative development steps. This leads to short-term partial results. The agile phase minimizes the risk of rework, delays, rescheduling and missed deadlines [9]. In the process, Water-Scrum-Fall can promote the separation between testing and development, so that testing becomes part of the release process. As soon as all requirements have been implemented by the development team, the agile part of the project is ended. In the final phase of the project, the agile solution is again delivered using the traditional procedure based on establishing quality control gates to reduce the frequency of software releases [29]. The product has typically already been tested to a certain extent at this point. This helps to manage high level test and project acceptance criteria [21].

Water-Scrum-Fall is a good introduction for companies that have been used the traditional approach and are now taking the first step towards agile. It also requires new roles that did not previously exist in the company. Scrum requires beside the development team the filling of the roles of "Scrum Master" and "Product Owner" and the assignment of specific rights and responsibilities [42]. The team itself is cross-functional, but there is no clear or strictly described team architecture.

Waterfall-Agile

At first glance, the methodology of the Waterfall-Agile model (Figure 3) seems very similar to West's Water-Scrum-Fall methodology. However, these two methodologies differ in the final phase. For example, West's final phase is based on the traditional project approach. The final phase of a project which uses the Waterfall-Agile methodology [15] is still within the agile approach. The project plan is scoped, and the first agile sprint planned before the start of the project [15]. This requires a complete project plan, but specific details of each sprint are not defined until the first sprint is completed. The development, design, and implementation are based on agile methodologies. At each iteration, the requirements are defined, and customer feedback is sought. Tests are carried out and corrections made to allow for continuous improvement. The contents of the individual project phases are sensibly selected and assigned before the start of the project but can be exchanged in the further course of the project according to the specified amount of effort.

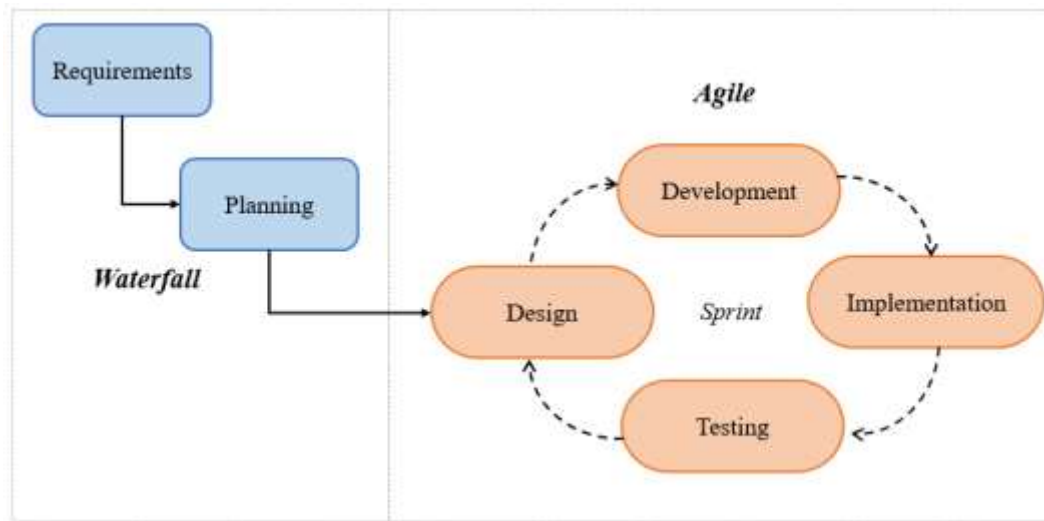


Fig. 3. Waterfall-Agile diagram. Source: adapted from [15]

The formal and traditional approach is used to define the outcome for each iteration [15]. The implementation is very agile within the individual phases. Agile shortens delivery time and facilitates early-stage feedback gathering to better meet customer requirements. The development and the test take place with short agile sprints, which are often implemented with Scrum.

According to Hassani et al. [15], there are various roles at Waterfall-Agile which are taken on by the project team. In traditional shaped projects, the project manager is responsible for the planning and managing the project so that it is successfully completed, and the project objectives are achieved. The project manager ensures compliance with defined workflows and can realize the requirements fixed at the beginning of the project at defined costs and deadlines. Developers are responsible for processing the individual work packages. The tester is responsible for monitoring the achievement of quality objectives and testing the product. The Waterfall-Agile methodology is unique in that there is no clear specification as to where, when, or how traditional planning transitions into agile implementation. This is something that can be decided on a project-by-project basis. It is also quite possible that the project is defined and planned with an agile approach, and then later developed and implemented according to traditional procedures [15].

Hybrid V-model

The hybrid V-model (Figure 4) by Hayata & Han [30] is similar to Water-Scrum-Fall in the sense that it uses a traditional approach upfront and at the end, with an agile phase embedded in between. However, this methodology should be considered as a new separate methodology as it is not based on the Waterfall methodology but on the V-model, which is another traditional type of methodology. In this pattern, Scrum is inserted into a traditional software development and IT project management process. The idea of this hybrid methodology is to conduct the phases with a "higher abstraction level" according to the V-model, while the more detailed phases are done according to Scrum. Scrum is particularly suitable for this, because here communication within the development team is exercised very intensively and thus supports the implementation phase through joint iterative thinking [30].

The V-model is a process methodology for software development and, like the Waterfall methodology, it organizes the software development process in phases. In contrast to the Waterfall methodology, it permits feedback to preceding phase [23]. A further and important extension of the V-model are the quality assurance measures, as the individual development phases are confronted with test phases and prototypes are provided during the development, which causes

an improvement and a warranty of the quality [23]. By the iterative development not only project risks are minimized, but one has a better overview of the total costs of the entire project and system life cycle [23].

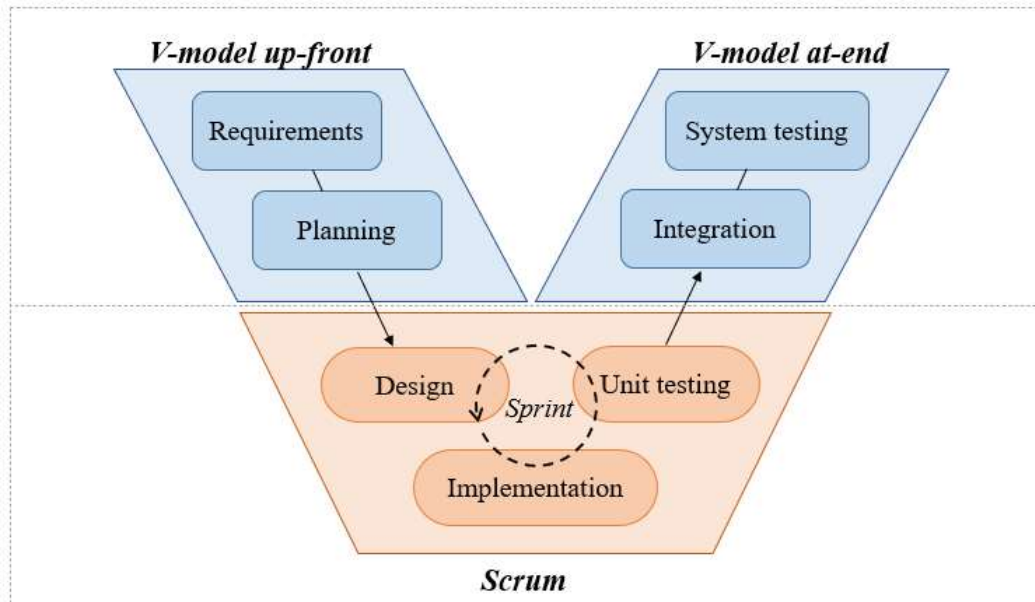


Fig. 4. Hybrid V-model diagram. Source: adapted from [30]

In the hybrid V-model, the traditional approach is applied to the project in the initial and final phases, where, according to the authors, there is a greater need for planning. Then, the agile approach is applied to the development, implementation, and testing phases, where the need for agility is greater [30]. On the left, user and system requirements can be gathered, specified, and analyzed at the beginning of the development project [30]. This can minimize potential disagreements over project goals as they are clearly stated. At the bottom of the V, the agile approach is used for design, implementation and unit testing, establishing an iterative way of working and thus reducing the risk for delays [30]. Subsequently, on the right side, the implementation that has taken place is tested according to the specifications from the left side. Through these tests, the V-model provides a high level of product safety and quality [30].

Agile-Stage-Gate (Scrum-Stage-Gate)

The traditional stage-gate process introduced by Cooper [43] has become one of the standards in product development worldwide. The original Stage-Gate process was created in the late 1980s to address the need to incorporate best practices into new product projects in a more systematic and disciplined manner [12]. Sharp, early, and fact-based product definition was a foundational principle of the original stage-gate methodology [13]. The methodology is based on multiple stages. Each stage includes cross-cutting activities from the task spectrum of different functional areas or departments of a company [13, 45]. Once the individual stages have been completed, the results are reviewed using predefined criteria as part of a milestone analysis (gates) [45]. In the process, defined milestones are used to check whether the planned development results have been achieved and whether they meet customer requirements [46]. The aim of the methodology is to ensure process quality in innovation development. The traditional stage-gate process may be too linear, too rigid, and too planned to handle today's more innovative, dynamic projects. According to critics, it is not adaptive enough, it is not context-based and it is too bureaucratic [12]. This plan-driven methodology requires that project decisions are made early and plans are adhered to during development. Deviations can only be detected after the

fact and compensated for with a time delay. The stage-gate process is hardly capable of taking into account the new dynamics and the increase in product complexity [46].

The hybrid Agile-Stage-Gate methodology (Figure 5) integrates agile sprints by breaking the development process within stages into short increments driven by short-term, minimal planning [43]. Replacing traditional project management tools, such as Gantt charts, milestones, and critical path planning, with agile tools and processes embeds the agile way of working within Stage-Gate [13]. This seeks to add flexibility and speed while retaining the useful structures of Stage-Gate. The use of Scrum does not necessitate the elimination of Stage-Gate. Instead, Scrum can be combined with Stage-Gate to create a hybrid Agile-Stage-Gate methodology that contains features of both systems [48]. The existing Stage-Gate-system provides focus, structure, and control, with the benefits of an agile approach and mindset like speed, agility, and productivity [13]. Each stage is composed of a series of time-boxed sprints. This adaptivity is accomplished through the incorporation of iterative development cycles designed to get something in front of potential users early and often. Each sprint begins with a sprint planning meeting, in which the project team determines realistic goals for the sprint and then maps out an action plan to accomplish those goals [12]. Each day of the sprint begins with a daily scrum, or stand-up meeting, in which the team members review what was accomplished the previous day, what the plan is for today, and what problems have arisen. In each iteration something like a rapid prototype or a representation of the proposed product, is built to show the customer [12]. At each stage, the adoption of agile *sprints helps to increase responsiveness and adaptability and minimizes drawbacks* [19]. Its core element is a continually evolving product definition that emerges through short-term, dynamic planning [13].

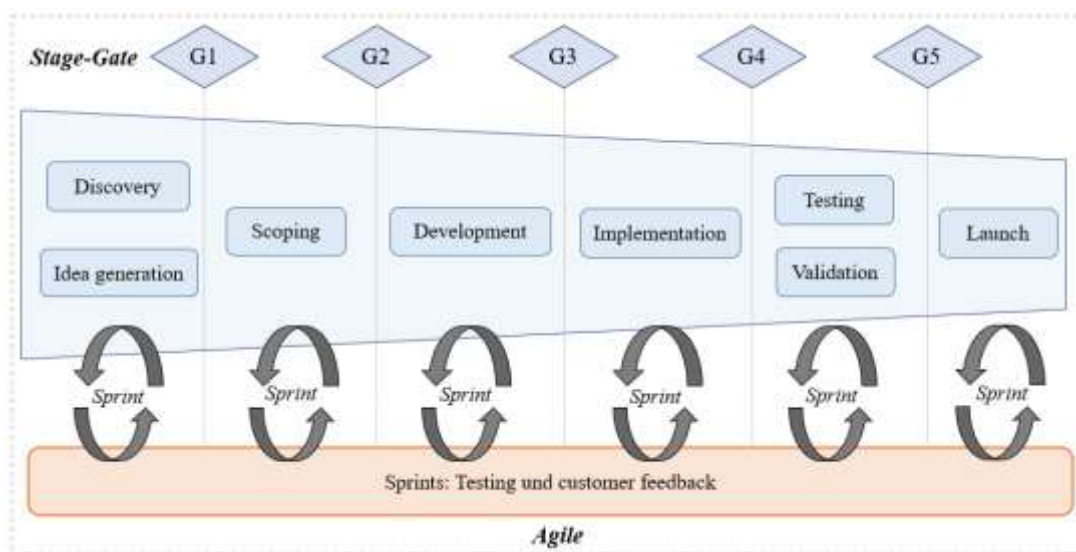


Fig. 5. Agile-Stage-Gate diagram. Source: adapted from [2, 12, 48]

Within the stages, the project is driven forward on a tactical and operational level. In each stage, the traditional and agile approach run simultaneously. Strategic decisions are made with the help of the stage-gate process. The operational one is carried out by the agile approach. The process follows a superordinate Stage-Gate process with the usual five phases (1. idea generation, 2. prototype, 3. development, 4. validation, 5. launch) and any number of Scrum iterations embedded in the stages. The Agile-Stage-Gate methodology is designed for one or several teams to perform activities simultaneously. The work results are compiled by the teams at the end of the processing stage and analyzed together.

Typical agile roles are also relevant for Agile-Stage-Gate, including product owner, Scrum master and development team [43]. The agile roles give new sense of ownership, increased motivation, and enhanced communication and knowledge sharing. The Scrum master tasks range from communication between stakeholders to information gathering to organizing adequate resources. In addition, so-called gate keepers, who dictate the progress or termination of the project between the stages, can be added to the roles of the project team [43].

Frequently, the literature also refers to a Scrum-Stage-Gate methodology. This is not another hybrid methodology but is the same as the Agile-Stage-Gate. The difference in the name is due to the fact that the agile sprints are carried out with Scrum. In the Agile-Stage-Gate methodology, the agile approach is kept general and does not necessarily have to be Scrum. The Scrum methodology is the particular agile approach that seems most appropriate for hardware development, and indeed, is the methodology used for all the hardware case studies uncovered so far in industry [43]. Therefore, the two methodologies Agile-Stage-Gate und Scrum-Stage-Gate have been summarized as one approach (see Table 3).

3.3 Advantages and benefits of hybrid project management

Hybrid project management is designed to maximize project success [17, 22]. Nevertheless, there are some advantages and disadvantages of this project management approach. In this section, we analyze the advantages and benefits of hybrid project management. We have defined “advantages and benefits” broadly as any positive effects that may result for the project or the organization as a result of using the hybrid approach to project management. The advantages include the increase in efficiency [5, 29]. Due to the larger selection of techniques and methods, a suitable tool can be applied depending on the project type and project status. In this way, the project benefits can be increased under certain circumstances, a better result can be achieved, and the goal can be reached more quickly with lower costs [13, 20]. At the start of the project, it is often unclear how the project goals are to be achieved. Through the hybrid approach, the project's target plan can concretize the objective step by step, even with long-term planning of time, costs and milestones [15, 22, 29]. The focus is on customer requirements and benefits [4, 18]. Permanent feedback ensures that the product will generate the highest customer benefit [17]. Another advantage of the hybrid approach is the higher creativity in finding solutions. Through iterative detailed planning [15], the project team develops the optimal solution variant for the current project status in individual iterations. If changes do occur, the hybrid approach can be used to deal with these changes flexibly. Hybrid project management with an agile component in project implementation allows to react much more flexibly than would be the case with purely classic project management [5, 8, 12, 15, 18, 32]. On the contrary, changes in prioritization or new requirements can be incorporated flexibly without having to completely reschedule the project. A side effect of the hybrid project management approach is motivated project teams [28]. By eliminating the classic leadership roles, the employees will achieve the project goal on their own responsibility [4]. This not only increases employee motivation, but also the personal development of team members in social as well as professional competence [32].

3.4 Disadvantages and challenges of hybrid project management

Despite all the advantages, there are also disadvantages of the hybrid project management approach that should not be ignored. For analytical purposes, we have defined “disadvantages and challenges” broadly as any “hurdle, barrier, concern, or critique” [49] towards the hybrid approach. A major disadvantage is that comprehensive methodological knowledge is necessary for the project management and the team [28, 41]. Everyone working on the project needs a high level of methodological competence [32]. The challenge is to select the right tool in the first step and to apply it correctly afterwards [22]. Only in this way can the advantages of hybrid project management unfold their full potential. Therefore, an increased need for training and familiarization should be planned for [22]. The hybrid approach also requires a high degree of transparency and communication [1]. Risks, problems, and errors are addressed directly, constructive criticism is voiced, and solutions are sought together. By handling information transparently, hybrid project management enables decisions to be made based on the most complete information possible. However, this is only possible if there is comprehensive communication, particularly at the interfaces between the methodologies [24]. This in turn leads to an increased administrative effort, through corresponding reports and documentation [20, 21].

3.5 Suitability for type of projects and firms

In recent years, interest in the hybrid approach has increased. Hybrid methodologies are used more often regardless of the size of the organization, industry sector or type of the project. According to research by Kuhrmann et al. [47], the hybrid approach prevails and is used by companies regardless of their size and industry. However, it can be said that large-scale organizations are more likely to adopt a hybrid approach, combining the traditional and agile project management approach [16, 19]. As pointed out in the literature, hybrid project management is easier to implement in large enterprises. Organizations with multiple teams display an increased use of hybrid methodologies [28]. Therefore projects with a high number of team members might be best suited for hybrid project management [5]. Especially large organizations with well-structured processes with systematic milestones are suitable for the implementation of an hybrid approach [16]. Hybrid project management is particularly suitable for large projects, nevertheless Alves et al. [21] state that the hybrid project management approach can also be used in small and medium-sized companies. Small and Medium Enterprises (SMEs) usually need simpler solutions and easier-to-use-systems [21]. Very small projects do not require a hybrid approach [15], the effort in implementing the hybrid approach and making them a success is not worth it.

Hybrid project management methodologies are suitable for projects that involve great uncertainty or are risky. Brandl et al. [8] add that the hybrid approach is particularly fitting for heavy-weighted, complex or business-critical innovation projects [8]. Kosztyn et al. [50] mention that a software development project is more likely to survive the risk effects if its project plan is managed by a hybrid project management approach [18]. The great benefit of the hybrid project management approach is that they are suitable for all types of projects, regardless of company size or project complexity [15]. The hybrid approach can be applied to physical products (hardware, not just software), from food and toys to heavy industrial equipment [12]. Innovation projects in high technology-based companies also benefit from hybrid methodologies [16]. Especially in software development or digital projects, there are hardly any limits with this solution.

3.6 Prerequisites and success factors

Finally, there are several “prerequisites and success factors” to using hybrid project management, which we define as any factors that enable the successful adoption of hybrid project management, or, should be fulfilled before being able to successfully adopt the approach in an organization. The implementation of hybrid management requires a clear alignment between the project team, the organizational objectives, and the project implementation team [19]. Often it is not easy to combine different traditional and agile methodologies, because they are two completely different approaches. The problem is determining which features or components (agile or traditional) are necessary for the hybrid approach architecture to be developed [44]. This statement make sense considering that a major project can rapidly become chaotic without at least a high-level planning and without documentation [21]. However, because the goal is to achieve the best result, project teams may believe they need to apply more than one approach [6]. At the start of the project, it must therefore be clearly defined which part of the project is to be pursued and which project management methodology should be used. Both management and developers agree that actual development does not adhere strictly to current methodologies anyway. Especially under deadline pressure, development proceeds spontaneously and shortsightedly [45]. Nevertheless, adjustments or changes to the methodologies can always be made later, should problems or changes in requirements arise. Organizations should therefore always decide individually which methodologies and techniques are best suited for a project. This is the only way to achieve the desired goals in the team in the long term. Customer-centric methodologies make sense in order to counter the sometimes difficult framework conditions of hybrid touchpoints by having experienced consultants flexibly align the adaptation of proven agile frameworks to the circumstances of the organization. Employees and team members should be open to new methodologies in order to give the hybrid approach a chance. All team members who participate in hybrid project management should have a broad knowledge of the agile approach, even if they have previously only worked traditionally. The hybrid approach does not need to be completely relaunched. In most cases, it is sufficient to use the existing processes, which is in majority of cases a traditional approach [5]. The team characteristic is typified by the fact that the team present good tolerance for alterations and deal with frequent changes of scope, so are more appropriate for the development of innovations [20].

Before adopting or introducing hybrid methodologies, especially Agile-Stage-Gate, firms should have already successfully used an traditional approach and methodology such as Stage-Gate-Systems [13]. This makes the transition or change to hybrid methodologies easier. It is also recommended to first develop a landscape framework [20]. Hybrid methodologies also requires a change in company culture, norms and processes [28]. The project team and its members must be highly connected and engaged with the entire organization. It is difficult to manage when the team is globally distributed, as much time is spent in meetings and large projects are split into smaller interconnected sub-projects. The involvement of several consultants and partner companies facilitates the use of an hybrid project management approach on top [20].

4. Discussion

In complex environments, project management requires the application of increasingly refined sets of techniques and tools, which can be adjusted according to the particularities and the evolution of each project [20]. These adaptations should consider the requirements and specific influences and wishes of the customer, which makes hybridity a suitable solution in project management. The systematic literature research has shown that there are various hybrid project management methodologies that combine different traditional and agile methodologies. There is no doubt that project management will change even more and must have many new system components as well as methods and interfaces. Today's organizations need to balance the specific characteristics of their environments and their projects with the need for greater agility to respond to the demands of innovation [20]. Traditional project management is no longer sufficient on its own, especially against the backdrop of digitization and technological change and increasing complexity. The agile approach assumes a flexible project structure, where dependencies between tasks can be flexible and lower-priority tasks can be postponed until the next project [18]. Given the strengths and weaknesses of both approaches, a combination seems to make sense, depending on the specific firm and project characteristics, as discussed above. In order to give a structured overview of these findings, we have summarized the findings regarding our research questions 3, 4 and 6 in Table 4.

Table 4. Summary aspects of the hybrid project management

Advantages / benefits	Disadvantages / challenges	Prerequisites / success factors
Efficiency improvement	Comprehensive methodological knowledge required	Clear coordination, high-level planning, detailed documentation
Maximization of project success, better result	Training and familiarization required	High number of team members, well networked, open to new methods
Flexible response to changes	Increased administrative effort (reports and documentation)	Use customer-centric approaches
Rapid achievement of project goals at lower cost	High level of transparency and communication necessary	First develop a landscape framework
Higher creativity in finding solutions		Good tolerance for alterations Already successfully used traditional approaches, a broad knowledge of agile methods Involvement of experienced consultants

When analyzing the specific advantages and benefits of hybrid project management, it seems that the advantages they offer are very much associated with the agile approach. Consequently, that would mean that hybrid project management only offers substantial benefits compared to traditional project management, but not compared to agile project management. So what is the value of the hybrid approach? In our view, the hybrid approach enables companies to use certain agile practices, even if there are constraints that impede the adoption of a pure agile approach. As previously

noted in the literature [4, 9], there are several reasons why organizations only gradually move from traditional methodologies toward the agile approach, including governance and compliance requirements, as well as, budgetary and time requirements that need to be considered. Especially large-scale organizations tend to experience many challenges when adopting agile methodologies, as the agile approach has been designed for smaller projects [51]. This idea is consistent with the finding that hybrid project management is especially suitable for larger organizations and projects (section 3.5). Hence, it can be said that hybrid project management helps certain types of organizations to adopt agile practices that would otherwise not have been able to so.

Additionally, our review has shown that hybrid project can mitigate risks compared to pure agile approaches when projects are exposed to great uncertainty or risks. Some papers demonstrate that a hybrid approach to project management can provide potential improvements, that is, they can provide the same budget, time, scope and quality outcomes as the traditional approach, while at the same time attaining the same level of stakeholder success that the agile approach delivers [4]. Organizations aim to achieve more flexibility by integrating the hybrid project management approach in their companies. A software development project is more likely to survive if a project plan is managed by a hybrid project management approach [18]. Hybrid project management provides a way to manage and implement projects more effectively and efficiently. Hybrid methodologies allow both planning and the flexible structure, and therefore, it is assumed that this is the supreme technique of project management. This assumption is reinforced by the fact that this technique provides the highest ratio of feasible solutions and the best scheduling performance [17]. Although agile thinking was first adopted in the context of software development, both agile and hybrid methodologies are not limited to this domain and are suitable for various contexts [35].

Against the background of global and virtual working teams, project management will be even more in focus for organizations to work productively. These hybrid systems that enable iteration and continuous evolution represent the future, according to some authors [12]. Future application development professionals will likely apply the most appropriate hybrid process to each problem. The hybrid approach might form a significant portion of the project population in the future [4, 9].

5. Conclusion

5.1 Summary and implications

We have presented a synthesis of findings from a systematic literature review in order to provide an overview of different definitions and methodologies to hybrid project management, including for example the Water-Scrum-Fall and Waterfall-Agile methodologies. Additionally, we have discussed advantages and disadvantages of the hybrid approach, as well as, their suitability and prerequisites. Important for the successful implementation of the hybrid approach are certain structural requirements that enable a more agile project management approach to deal with the rapidly changing requirements and the uncertain, highly complex, and turbulent environment [8].

This research highlights the increasing importance of the hybrid approach. This has important implications for both, business organizations and academia. Organizations should consider the hybrid approach as an additional option to traditional and agile project management when selecting a suitable project management approach. Above all, new competence profiles for project control and implementation must be given greater consideration in the education and training of project managers and project teams. Academia should incorporate the topic into their curriculums and furthermore address the research gaps that are presented in the subsequent section.

5.2 Research gaps and future research directions

While we were able to find some answers to all of our pre-defined research questions, we also have identified a number of shortcomings and research gaps. These are both, gaps in the content of the research, as well as, shortcomings in the methodology and robustness of studies. In the following paragraphs, research gaps and opportunities will first be discussed for the theme of *development of hybrid methodologies*, before the *evaluation of the hybrid approach* in general, as well as, the *evaluation of the different hybrid methodologies* will be analyzed.

Regarding the question how traditional and agile methodologies can be combined in a hybrid project approach, it can be summarized that various new methodologies have been proposed by a number of authors. While these methodologies are interesting and have advanced the discussion in the field, a general procedure to develop a hybrid approach or criteria to guide a meaningful combination of traditional and agile elements are still missing. An interesting future research opportunity is therefore to develop procedures, criteria or frameworks that help organizations to select appropriate methods and design bespoke hybrid methodologies that are tailored to the specific project and organizational context. This can include general recommendations to guide the process, as well as, specific factors that influence the suitability of certain practices for the specific environment.

Moreover, we see major research gaps in the evaluation of the hybrid approach to project management, i.e. the question of advantages, benefits, disadvantages and challenges. First, as explained in the discussion section of this paper, the advantages of the hybrid approach that can be found in the literature seem to overlap with the advantages of the agile approach. Therefore, more research is necessary to better distinguish between these two approaches in the evaluation. Second, only few papers [4, 17] systematically evaluate the success of the hybrid approach. We acknowledge that project success is a concept that is difficult to measure. Nevertheless, the scientific examination of the relationship between project approaches and project success is essential for an overall evaluation of the project approaches. Third, the robustness and academic rigour of some results in this category seem to be questionable. While the results appear plausible, many findings seem to be based on personal experience and narrative evidence by the respective authors, rather than empirical findings. Only few studies are based on quantitative empirical [4, 17] or qualitative empirical methods [22]. We therefore recommend to increase the number of studies based on a robust research design to evaluate the alleged superiority of the hybrid approach.

While we have made a first step to compare the different individual hybrid methodologies in a structured way, clearly more research is necessary to validate these methodologies. Moreover, we recommend to evaluate the advantages and disadvantages of the individual hybrid methodologies against each other, using a structured and rigorous research design.

5.3 Limitations and threats to validity

We are aware that our research may have some limitations. As our results rely on prior research that was conducted in specific contexts, the generalizability of some results might be limited. Additionally, limitations and bias from previous studies might have been adopted into our research.

Moreover, some threats to validity may arise from the design of our systematic literature review. To identify and discuss possible problems, we have taken into account typical threats to validity of systematic literature reviews, as pointed out in the literature [52]. First, threats to validity may arise from incorrect or incomplete search terms. This may also be applicable to our research, as designing a search string is always a trade-off between comprehensiveness and feasibility in terms of the number of results that can be manually evaluated. However, we have tried to mitigate this risk by experimenting with different search terms in several explorative searches, before determining the final search term. Second, the choice of databases may be a threat to validity. In general, individual databases only include a selection of the universe of literature due to incompleteness and deliberate selection. Our search was deliberately limited to the WoS database which only includes high quality academic literature from various publishers and organizations. Using additional databases which are less selective in terms of quality, as well as, integrating grey literature may bring up additional findings. However, due to the backward search that we have conducted, we are confident that the selection bias could be limited while maintaining a quality filter through the initial search. Third, in the manual screening of the articles, subjectivity is inevitable. We have tried to increase objectivity by using guiding research questions as inclusion criteria, as well as, by critically discussing the inclusion and exclusion of individual articles within the team of authors. Overall, due to the transparency in the explanation of our research design, we are convinced that our study is replicable and that other researchers will be able to evaluate the strengths and limitations of our research when interpreting the results.

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