

TOWARDS A HYBRID PROJECT MANAGEMENT FRAMEWORK:

A SYSTEMATIC LITERATURE REVIEW ON TRADITIONAL, AGILE AND HYBRID TECHNIQUES

EMMANOUIL PAPADAKIS, DOCTORAL RESEARCH
DR. LOUKAS K. TSIRONIS, ASSOCIATE PROFESSOR

DEPARTMENT OF BUSINESS ADMINISTRATION OF THE
UNIVERSITY OF MACEDONIA, GREECE

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REVIEW

Abstract: It is the state of the practice in these turbulent times to combine different approaches and project management methods into hybrid and adaptive methods according to the specific needs of the project and the project team. The objective of the present work is to investigate this practice by conducting a systematic literature review on project management methods, hybrid agile methods, method tailoring, and innovative processes to tailor methodologies. We applied a systematic analysis of the existent research published during the period 2000 – 2020 following similar approaches of several scholars. 1.121 articles published from 2000 until 2020 were collected after an exhaustive literature search. However, 98 of them were selected for further investigation according to the criteria selected. Results provide key insights and background on agile project management frameworks as well as challenges and best practices implementing an inhouse hybrid agile project management framework. We anticipate the present work to constitute a useful source of information to PM scientists and practitioners. Results identify new dimensions emerging of the synthesis of project management aspects and provide key insights on traditional and agile project management frameworks as well as challenges and best practices implementing an inhouse tailored hybrid agile project management framework. This work contributes to the body of knowledge about the organization, mainly of agile and hybrid approaches. We analyzed the found descriptions thoroughly regarding their characteristics and their organization.

1. INTRODUCTION

The dynamics of evolving markets and the transformation of economies into services ones create new challenges in the way projects and programs are managed [1]. Customers demand it is no longer tangible, high-quality products, but they rather prefer a type of service. Under this shift towards a service economy and the aggressive competition, organizations acknowledge the way to fast-track value creation [2] and achieve strategic priorities working with projects and project portfolios [3] [4] instead of handling operations. Many of them are transformed, becoming project-driven and adopting new delivery methods. Concurrently delivery methods and practices utilized in projects are also challenged. Moreover, traditional organizations [5] unsuccessfully consider applying ready-made, project management methodologies and frameworks. They discover that these methodologies are inappropriate for their projects' context and incompatible with the level of maturity of their organizational project management. Many researches argue that the traditional PM (e.g., waterfall) are best suited for large scale projects where various disciplines are being combined [6]. The reason for this is that large projects demand matching requirements and specifications, so traditional PM are able to assure the final outcome [7]. However, when they fail to apply traditional PM, they turn to agile methodologies. On the other hand agile PM supports fervently small scale iterations, has a team-based character and requires immediate problem-solving abilities. Furthermore, APM indicates faster reaction capabilities when there is a need for faster new product releases in the market [8], resulting in on-time delivery, customer satisfaction and business value creation. On the other hand, APM requires management commitment, established communication and a culture willing to face new challenges [9]. It is obvious that there is a "war contest" between the supporters of APM and TPM methods. Nevertheless, success can rely on the synergy between TPM and APM, because both agility and discipline can assure the best result (Boehm 2003). The current work aims to identify if there is space for hybrid PM to support all project types, large and small. Agile is the ability to deal with change, embrace change as a positive force and harness it in order to increase customer value and achieve competitive advantage [10]. To clarify, there are also a mindset, culture and value-driven aspects that accompany the notion of agile, not just only the process aspect. The term practice is understood as "something that is usually or regularly executed, often as a habit, tradition, or custom" , and we consider an agile practice

as a main element, i.e. daily meetings or short iterations [11] which emerges from an agile method either used in its authentic or a tailored form. Tailoring is the selection and alignment of specific business practices and methods depending on the type of project [12]. Moreover, the literature examines, among others, modern applied agile practices, tailoring endeavors and related adoption issues. We also need to emphasize the context of services because services differ from tangible products due to the four unique characteristics of intangibility, heterogeneity, inseparability and perishability [13]. The objective of this article is to provide a thorough SLR and focus on the state-of-the-art PM methodologies and approaches applied in different scenarios and contexts. The article selected concern every aspect of TPM and APM regarding applications, combinations, use cases and synergies of methods, practices, techniques and approaches. Aligning with Papadakis & Tsironis [14] and Niederman et al. [15] the scope of the present work did not restrict but expanded to all disciplines, focusing on services and including two more years, from 2017 till 2019. Apart from the discussion and analysis of all related literature, the contribution of the present work is to identify which PM aspect can be used to fulfill which task. In this context, several endeavors in developing hybrid methodologies have been proposed and may have been applied. However, evidence of contextual factors and patterns leading to the development of hybrid approaches is yet missing. The rest of the text is divided in sections. Section 2 discusses the background and related works while in section 3 the proposed methodology unfolded. Section 4 exhibits and discusses the results of the research. The conclusion and future work are presented on Section 5.

2. BACKGROUND AND RELATED WORK

The literature states clearly that the progress of PM is determined by the APM rationale [10]. It is no coincidence that 71% of PM efforts at any project scale involve developing an APM approach. How could that not be the case when globalization is affecting supply chains as it is about adopting new strategies to achieve the best results. Also, problems such as bureaucracy, budget overruns, delays and excessive rigidity make this shift more necessary and call into question the success of the Stage-Gate process in today's uncertain and rapidly changing global environment [16] [17]. However, as agile methods evolve challenges arise. From the earliest attempts of literature search, it became apparent that recent works is rich in APM approaches [18], while TPMs appear to remain stationary, though irreplaceable, for specific tasks [19], [20], [21] ,[22].

Several articles promote the involvement of human and social factors, which influence the successful project delivery. Thus they establish a connection with the importance of adopting agile approaches [23], [24], [25],[26]. Other authors support their adoption in order to have a balance between team members, teams and organizational responsibilities in project delivery [20], [27]. Kuhrmann et al. [28], for example, argued that hybrid methods became popular among PM organizations regardless of their size and discipline. Furthermore, they investigated drivers and triggers that create a need for a hybrid approach and concluded that a hybrid approach is required in a project progress.

In their study [29] retrieved and analyzed 28 systematic literature reviews articles, focusing on ten agile software development projects research areas including adoption, methods, practices etc. They also pointed out the first two authors with the majority of authored SLRs. Other authors support the existence of a hybrid methodology, although other researchers observe incompatibilities. Another recent study of Conforto & Amaral [30] examines and empirically analyses a hybrid PM framework that combines APM and a stage-gate model. They indicate its positive impact on the project and product development performance. Similarly, Cooper and Sommer's [31] hybrid framework highlight the power it has to micro-planning of day-to-day work.

2.1 Hybrid approaches related work

A hybrid approach definition could be the combination of two different methodologies, agile and traditional or a combination of systems that produces a new and more efficient model, according Kuhrmann et al. [28]. On the one hand, these "dual" approaches acknowledge the fluidity of projects and give extra nimble and nuanced characteristics to the project work. They can fully be applied or can be set partially on specific aspects of the project work. It may fairly be said that the more ways you have to approach a problem, the better chance you have of it being resolved. At the other hand, plan-driven structured and agile development methodologies have also their strengths and risks [32]. Combining the agile mindset with the plan-driven structured frameworks, the outcome could be a hybrid approach that improves corporate policies and procedures and promotes flexibility and productivity [33]. Therefore, a mixed approach could be build based on the unique strengths of both approaches eliminating their weaknesses [34]. A hybrid model was presented by Mukhtar et al. [35]. They introduced this

model as an evolution of the Agile Software Development Practices by using Artificial Intelligence (AI) technique. Kuhrmann, Diebold, Münch, & Tell [28] concluded that hybrid approaches are independent of the company size and that external factors do not trigger the development and application of them. Additionally, relative results from data analysis suggest that a hybrid approach is an effect of a natural evolution of the development approaches that companies apply. In their work, Boehm and Turner [20] examine how agile processes can blend with standard industrial processes without disrupting business operations. They proposed approaches that assist organizations to integrate agile practices into their traditional processes. A novel hybrid methodology have been proposed by Keith et al [37]. Leveraging a design science approach the proposed methodology, called SoMSD, was based on concepts from the service-oriented paradigm using theory on modularity and service-dominant logic.

The following table provides several research papers that study hybrid approaches and challenges.

Reference	Research questions/goals	Year
1 [35]	Propose a hybrid model by using an AI technique	2013
1 [38]	Investigate the application of different models in software development and potential combinations	2015
2 [37]	The aim is to identify, apply and test specific principles for a service oriented methodology	2013
3 [39]	Review current state of agile adoption, propose a new approach by blending Scrum, with plan-driven project management methods	2011
4 [40]	This research investigates delivery approaches that are used in practice, how they are differently combined and how external factors trigger hybrid approaches	2017
5 [41]	This article proposes an approach that combines best practices of both Agile and RUP while analysing their strengths and weaknesses.	2016
6 [42]	Describe a context-driven software process	2006
7 [43]	Pillars to spread and establish hybrid methods	2020
8 [44]	Agile and state – gate combinations, and when they can fit together	2020

Table 1. Studies proposing hybrid models and implementations

3. RESEARCH METHOD

This article focus on the systematic analysis and synthesis of the existent research published during the period 2000 – 2020. Respective approaches have been proposed at the beginning of the millennium by several scholars [45] [46]. Webster and Watson pointed out the importance of literature review in Information Systems (IS) and described very well the snowballing approach while Tranfield et al. [46] outlined the opportunities and threats when applying practices and methods developed in a medical context to management context. They argued that SLR is a main key research target for practitioners and academics and contributes to the visualization of the policies and practices in a research field. This further adds to the importance of SLR, which can help in supporting the

decision-making process based on evidence revealed and in future research efforts. Later on, Kitchenham and Charters [47] published a very interesting article undertaking the same approach. We followed the same rationale considering these scholar works to analyze and synthesize literature from the agile project management and related topics. Figure 1 presents the main steps of our review, which are explained in more detail in the following sections.

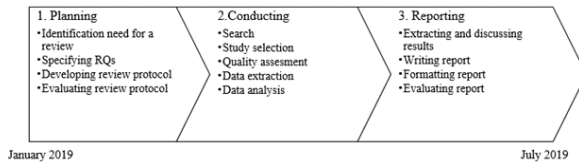


Figure 1. Phases of an SLR.

Considering the suggestions of Kitchenham and Charters [47] and as it is illustrated in Figure 1, we conducted the steps in the Figure 1a.

4. PLANNING THE REVIEW

During the planning review phase, the objectives of the review have been established, which in turn will advance the development of the review protocol. The review protocol establishes the strategy used to conduct the review process and is the instrument that specifies the research questions. In order to determine the specifics of the review process effectively, a preliminary review has been performed prior on the research topic. This action helped us to identify more relevant keywords and thus, more relevant results for constructing the research questions. Another result is the definition of the screening criteria for filtering the search process, which is significant for sustainable design, as it determines the quality of the results. Furthermore, in the planning step, identified specific categories of the extracted articles, which are useful in data analysis. The field of agile project management we are investigating presents a rich scholar contribution [48][49][50][51].

While it is considered very popular and interesting topic, the international discussion requires more specific views and works in the field of agile project management, hybrid methodologies, method tailoring [52] in non-software contexts [53] [54]. Considering this, this work focuses on elaborating on of the characteristics of agile project management and relative approaches, as well as to find out which are the objectives and methods followed by the researchers and how they achieve them.

The purpose of this step is to discuss the review protocol process and phases [45]. The review process provides details of the following elements: the search process and strategy, for inclusion and exclusion; the selection procedure; the data extraction procedure; and data synthesis.

5. RESEARCH QUESTIONS AND REVIEW OBJECTIVES

The research questions are considered as the most significant aspects of the review. They ascertain the scope of the SLR and drive the review process. The research questions have been determined according to the focus of this study. Our objective is to collect and examine the literature related to agile methods, proposed hybrid models with agile characteristics, other development methodologies and tailoring endeavors. Research question 1 (RQ1) aims to highlight most used agile practices, plan-driven approaches and hybrid methods. Provide an understanding of their application, identify the main characteristics of agile project management and determine the context where agile are prospering. Research question 2 (RQ2) is to deeply identify in the literature the existence of a developing hybrid methodology and efforts in method adaptation and tailoring. Determine the drivers used for method tailoring and categorize the retrieved research papers accordingly. Finally, research question 3 (RQ3) intension is to examine if there is any significant work in the literature, which examines agile, tailored/hybrid methodologies in a different

context other than software. This provides a broader view of how these methodologies can be applied in other environments. The review aims to answer the following three research questions (RQ):

5.1 Search process and strategy

In order to satisfy the objectives, we constructed the research questions shown in Table 2. The formulation of the research questions facilitates us to determine the search string shown in Table 4 and then serve to gather the start set of studies. In order to reduce bias, the articles were retrieved through Google Scholar than in other recognized publisher's databases such as Wiley online or Springer, or ScienceDirect-Elsevier and IEEE. The time period for executing the search was between 2000 and 2020. In order to retrieve the start set we made use of Publish or Perish software suite [55] running the specified query. We retrieved, for inclusion in our initial literature pool, in total 50 candidates (CAx) sources; they are indexed CA1, CA2 and so forth to state that they are appropriate for inclusion. To begin with, we determined the importance of the papers and then we searched the reference list of the pertinent papers in order to discover additional sources. In order to develop the initial start set of papers articles published on 2020 and before with no citation and non-peer-reviewed articles were excluded.

agile AND agile method tailoring AND method tailoring AND hybrid AND systematic literature review AND services

Table 3. Search string for the start set of papers

5.2 Search strategy

Subsequent to the definition the research questions and the objectives of the research we developed our research strategy. Relative work similar to the research topic at hand may be found in several other domains (i.e. computer science, technology, information systems, social sciences) and in various subdomains within these domains.

Keywords of the search string were derived from answering our research questions. Influenced by articles written [56], [57] and [58] we executed the systematic literature review. Based on the research questions, we determined the "search term" and defined the search string in order to collect our initial set of papers. The reason we examine the services environment is because the services sector has been developed over the last fifty years and dominates in most advanced industrial economies, while service innovation represents an important driver of economic growth. Today, General Electric and IBM, leaders in the manufacturing sector, moved their business orientation into services sector. Particularly, IBM receives the majority of its revenue from its business unit for global services which didn't exist prior to the 90s [1]. The search terms were connected using the boolean operator "AND" implying that an article should include all of the searched terms. The second step is to indicate if the collection of papers satisfy the selection criteria or not. Twenty one (21) articles were considered based on the citation and the relation with the specified criteria. We then studied, conducting a backward snowballing, the reference of the 21 selected papers (start set) to retrieve more papers. During the snowballing procedure backward and forward passes are taking place. The snowballing procedure is a structured iterative approach [56] during which we examine the reference list of those articles in the set and identify new papers. This is called backward pass. During forward pass, new papers are identified examining those papers citing the paper. The iterations stop when no new paper is retrieved.

5.3 Selection criteria

In order to distinguish irrelevant papers, we determined the inclusion and exclusion criteria. Selected studies were considered as eligible for inclusion if they had relevance with the research questions and the criteria summarized in Table 5 was fulfilled. The review included articles from both researchers and practitioners.

Figure 1a. Steps to follow.

1. Planning the review	2. Conducting the review	3. Reporting the review
<ul style="list-style-type: none"> a. identification of the need for a review (section 1) b. specifying the research questions (subsection 3.2) c. developing the review protocol (subsection 3.2.1, 3.2.3) d. evaluating the review protocol (conducted by the second author) 	<ul style="list-style-type: none"> a. execute the search (subsection 3.2.2) b. select the studies (subsection 3.3.1) c. conduct quality assessment (subsection 3.3.2) d. extract data and analyze them (subsection 3.3.3, 3.3.4) 	<ul style="list-style-type: none"> a. discuss the results (subsection 4.1) b. write the report (subsection 4.1) c. format the report d. evaluate the report (subsection 4.2)

Table 4. Search criteria (for start set)

Category	Source
On line bibliographic databases	Google scholar
Search items	Peer reviewed sources (journals and conferences papers) phd dissertations, on-line presentations, reports, reviews
Language	English
Citation number	More than one or equal

Selection criteria for	
Inclusion	Exclusion
Articles published on journals or conferences related to management, computer science, software engineering and software development	article summaries, discussions, interviews, news, reviews, comments, editorials, prefaces,
Published from 2000 to mid 2020	Published before 2000 ¹
Papers focus on agile practices, method tailoring, hybrid approaches and adoption models	Studies that do not have any link with the research questions
All papers published in English	Duplicate papers found while snowballing Papers that are not published in English language
Cited more or equal to one	No cited

Table 5. The criteria for article inclusion and exclusion

Figure 2 indicates the systematic review procedure and the number of articles retrieved at each stage.

6. CONDUCTING THE REVIEW

This section presents the findings from both the search and the extraction of information data.

6.1 Study search and selection

Taking into consideration the search strategy, the selected database was searched and the initial set of articles was retrieved using Publish or Perish 6.6 software [55]. In the citations of the start set (21 papers) were studied in order to retrieve more papers, when executing the backward snowballing. The papers were assessed one at the time. Then conducting the forward snowballing, we identified articles citing the key articles identified in the previous steps. 50 candidate studies were collected at the end of the first stage. Then, their classification took place by checking if the retrieved papers were not tutorials, editorials, discussions, prefaces, comments and presentations. During stage 2, the pre-selected studies passed a screening process based on publication year, language and citation number. In stage 3, twenty one articles (21) were gathered as the start set of selected articles.

Conducting again a backward and forward snowballing a number of 1.121 articles have been collected (duplicates and non-English articles have been removed). In stage 4, the screening process revealed a number of 259 articles.

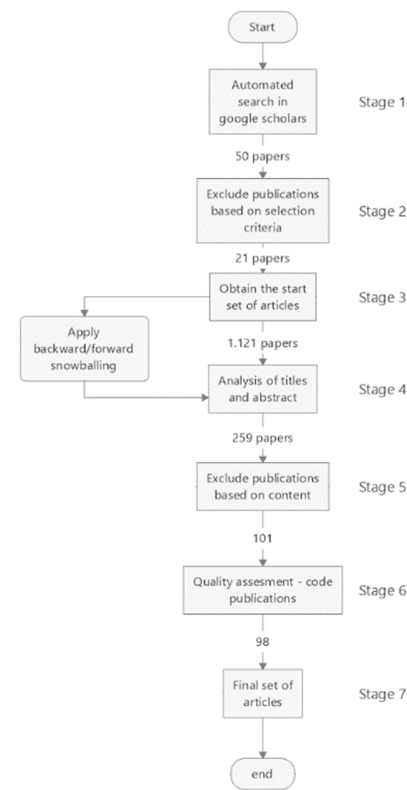


Figure 2. Search process comprising seven phases

Papers were included and excluded based on their titles and abstracts. During stage 5 the exclusion took place based on the article's content. This stage left a number of 101 (80 + 21 starting articles) articles.

6.2 Quality assessment

In the last 6th stage, 101 articles were reviewed (each one by both authors) and assessed applying the quality criteria addressed in Table 6. These quality criteria comprise questions that provide metrics to which a study is satisfactory and will contribute to the scope of our research. Then their quality has been assessed adopting the process from [59]. Four quality criteria have been established as shown on Table 6.

Table 6. Criteria for quality assessment

ID	Criteria	Score	Score according to Response option
c1	Is there a clear statement of the research goals	Yes = 1/moderately 0.5/no = 0	
c2	Is there an adequate description of the context in which the research was carried out?	Yes = 1/moderately 0.5/no = 0	
c3	Is the research method explicitly stated? Which research method was chosen?	Yes = 1/moderately 0.5/no = 0	
c4	Are the agile practices used mentioned in the paper?	Yes = 1/moderately 0.5/no = 0	

These established quality criteria correspond to three fundamental themes relative to the article's quality i)credibility ii)rigor, and iii)relevance. Each criterion is an asking question with a metric. Their metrics related to the criteria above have also been applied in other systematic literature reviews [59], [60]. The score assigned to articles was based on how well it satisfied the criteria. The total score was calculated by adding all the scores of the four criteria that each author rated. 101 articles have been assessed for their quality. Three articles were excluded, leaving in total 98 articles (77 articles and 21 articles of the primary start set at stage 7).

6.3 Data extraction and synthesis

The first author conducted the extraction and the second the review [61], [62] by tracing back and checking the correctness of the information written in the extraction form. To conduct the extraction process Mendeley 1.19.4 [63] software application was used to document references for each study. Then, information was pulled out from the set of studies included at this stage according to a predefined extraction form. This form includes important information of the articles and defines how each of them relates to our research questions. The objectives, the applied research methods, findings, results and conclusions were copied then into Maxqda 18[64], a specialized software application for qualitative analysis of textual data.

6.4 Classification

Studies were grouped into special themes when the data extraction process has been conducted by the first author. Thereafter, the papers belonging to each theme were counted. These classification themes were: agile methods, tailoring approach, adoption approach, large scale approaches, success factors, plan-driven techniques, hybrid approaches, adaptive frameworks, conceptual model, challenges.

7. FINDINGS OF THE REVIEW

In this section and according to the research questions, we present the findings of the review. 98 empirical studies were identified with the agile development theme. We classified the studies into four main categories: (1) adaptation/adoption approach, (2) agile methods (3) hybrid approach (4) tailoring approach and (5) scaling agile methods. Then, the characteristics of the studies, the applied research methods and the quality of the studies are described and analyzed.

7.1 Overview of studies

Based on the analysis, the articles were grouped based to the applied research method. Of the 98 studies, 19% are case studies, 24% are systematic literature reviews, 18% are framework proposals, 17% are reviews and 22% are surveys. Studies are then grouped according the publication venue and publication channel. The majority of the studies are published from IEEE publication venue, while Springer and Elsevier represent a reasonable high number of publications among them.

Type	Number
ACM	7
Elsevier	23
Emerald	5
IEEE	22
Springer	13
Taylor-Francis	4
Sage	7
Other	8

Table 7. Distribution according the publication venues

Figure 3 classifies the papers by the year of publication. This classification indicates a recent growth from 2000 until 2009 for published papers relative to the research subject of this article. Slight volatility is observed between the years 2010 and 2020 while the years 2009, 2011 and 2017 show the greatest activity.

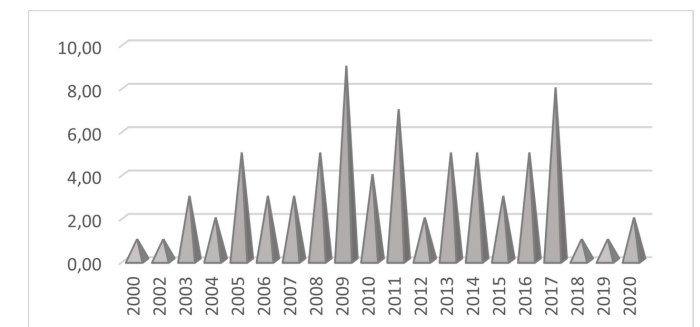


Figure 3. Distribution of studies yearly

Table 8 shows that the most adopted agile method is Scrum by 72%. XP is coming next by 61%. The other well knows methods like Lean, DSDM, Crystal and Hybrid have a significant appearance in the pool of elected studies. Several papers from our pool addressed how the agile development methods are introduced, tailored and adopted in organizations; These articles

Method	Number of articles	Percentage of total %	Method	Number of articles	Percentage of total %
XP	61	65	Lean	48	52
Hybrid	39	42	ASD	22	24
Scrum	72	77	FDD	19	20
DSDM	31	33	RUP	18	19
Crystal	36	39	Kanban	22	24

Table 8. Type of methods used or reviewed by the analyzed papers

fall into three broad collections, named method engineering, contingency factors and situational method engineering. Studying the method tailoring approaches we collected 8 papers talking about method engineering, and five for "contingency factors" and "situational method engineering" respectively. Of the 98 studies, about 69% were published in journals and 31% in conferences (Table 9).

Publication type	#	%
Conference paper	29	31
Journal	64	69

Table 9. Distribution of studies according to the publication channel

Regarding the origin industry it is clear that the software development sector is dominating by 85%. The main explanation is that Agile thinking [65] and Agile Manifesto [66] have been introduced from the software domain. However, these two concepts nowadays have been introduced and established in other sectors and contexts. Table 15 illustrates the primary data collection methods of the research papers. The dominant method for collecting data is literature reviews (55%) while questionnaires/surveys are coming next with a slight difference (45%). Interviews and focus group have a usage of 29% and 11% respectively.

Table 10 shows that most research examines the evaluation of agile practices, as well as adaptation and combinations.

	#	%	Id (Examples)
Evaluation of agile methods	41	44	10,12,13,16,20,22,23,24,33,35,36,38,43,44,47,49,51,56,57,58,60,61,64,65,66,68,69,71,72,77,78,81,84,85,86,87,88,89,90,92,96
Critical success factors	6	6	7,37,40,70,72,73
Scale agile	7	8	29,42,50,67,73,74,83
Adaptation/Adoption / Tailoring	32	34	1,2,3,14,15,17,18,19,21,23,28,30,31,32,34,45,46,48,53,54,55,59,69,75,76,82,84,85,91,92,93,95
Hybrid approach/combinations/frameworks	16	14	4,5,6,11,25,26,27,39,52, 63, 79,80,88,94,97,98

Table 10. Focus

"Method tailoring criteria" is also an important aspect that the literature investigates. Kalus and Kuhrman [67] and other researchers examined and analyzed these criteria and assembled the following criteria categories as seen on Table 11.

Table 11. Criteria used (frequency) for agile method tailoring detected on relative papers

Category type	Criteria	#
Internal environment	Project type	3
Internal environment	Business goals	1
Internal environment	Clear project proposal	1
Team	Team size	4
Internal environment	Organization size	2
Internal environment	Maturity level	1
Objectives	Complexity	2
Internal environment	Project budget	2
Team	Technology knowledge	3
External environment	User availability	1
Internal environment	Culture	3
External environment	Type of contract	1
Internal environment	Communication	4
External environment	Customer Involvement	2
Team	Distribution	1

8. DISCUSSION OF RESEARCH QUESTIONS

We answer the three research questions and gain a figurative view of the literature on agile project management, hybrid methods, tailoring methods and frameworks. The information collected is discussing the methods and practices being adopted and applied and investigates in several domains if agile thinking and approaches can be applied in a non-software context.

RQ1: *What emerging agile practices, development approaches and methods in creating tailored methodologies (e.g. hybrid methods and practices associated with agile and plan-driven) are trending in the delivery of projects? Selection and adoption process.*

In this research question, the analysis found nine agile methods. Potential respective challenges, benefits and limitations and success criteria have been identified for each method. This pool of agile methods should be considered as inclusive, meaning that it reflects what have been collected in the 98 studies. Table 12 indicates the frequency of occurrences and the studies reporting each of the methods.

1) Scrum is applied when a customer's requirements are not well known from the beginning of the project. On core function of the approach is that it provides flexible processes to deal with unpredictable changes and challenges. Deliverables are produced during several iterations (called "sprints"). Before the sprint starts a planning meeting takes place and ends up with a review meeting called retrospective. Self – organization is a very important attribute of this approach that should be pointed. So team members have autonomy when managing their work. Their work is a list of tasks, called backlog is maintained where the team members register stories and task items in order to facilitate the delivery process. On very important member of the team is the product owner who is responsible for communicating with the customer, decides which backlog items should be developed in the upcoming sprint. Every day daily stand-up meetings take place where the entire team is aware of obstacles, what stories are done or not, and what tasks are ready to be pulled from one team member's task list into someone else. Another important team member is the scrum master. He is responsible for coordinating the team, solve problems that stop the team from working effectively and generally look after the process. Yet, the Scrum model has the potential while improving the visibility of work, to support distributed development [68] [69].

2) Extreme programming (XP), likewise scrum, is a methodology with attributes to react quickly when changes occur, emphasizes in small release cycles and continuous improvement. XP is more lightweight and focuses on best practices for development and quality improvements on deliverables. [70]. There five core values that XP embrace: communication, feedback, courage, respect and simplicity. It has also consisted of twelve practices. Several approaches such pair programming, planning game, test-driven approach and whole team are aiming to provide feedback. The continuous process contains other three practices, continuous integration, design improvement and small release are other three practices aim to continuous improvement. Some literature states that XP is better applied when teams are experienced while other found difficulties introducing them in complex environments [59].

3) Dynamic systems development method (DSDM) is another agile project methodology framed into three phases: pre-project, project life cycle, and post-project. DSDM is built upon nine core principles: user involvement, frequent delivery, addressing current business needs, testing throughout the lifecycle, empowering the project team, iterative and incremental development, allow for reversing changes, high-level scope being fixed before project starts, and efficient and effective communication.

4) Lean thinking originally came from the automotive industry and Toyota [71]. Lean development follows seven principles: eliminate waste, deliver as fast as possible, empower the team, amplify learning, decide as late as possible, build integrity, and see the whole [72]. Lean thinking introduced in software development earlies 90s, howbeit lean principles could be also applied to other domains as Staats et. al [73] states.

5) Hybrids blend together practices from multiple methods, between agile methods or agile and plan-driven. A prerequisite to hybrid project management is that these combinations are feasible and necessary for projects that blend a mix of their home ground characteristics. There are several examples of such combinations like XP and Scrum, lean and agile, and customized agile methods. The study of Wang [74] showed that agile can be combined in different modes and for different purposes. Keith et al. [32] assert that to be successful, a hybrid approach must be able to modularize the IT project process into high and low-risk activities and breakpoints so that resources, technologies and techniques can be applied to each task. In their paper, Mukhtar et al. [35] implemented a model with three layers: RUP layer, integrated scrum layer and case based

reasoning (CBR) layer. The model elaborated on two fundamental concepts, the coordination between AI techniques and Agile software development. Kuhrmann et al. [28] proposed other combination patterns. Their study proposed two main categories (method and practice) and within each category three sub-categories (traditional, agile and both) were assigned. They found that a combination of different development approaches could be considered regardless of the industry sector. A study from Tanveer [41] proposed that Scrum and RUP could also be combined, introducing a hybrid solution in a large scale setting.

6) *Crystal* is also an agile approach based on that people play a very important role during the project development more than tools and processes. It is considered as a collection of methodology element that a firm can combine and use to satisfy individual project delivery. When adopting crystal methods, organizations may tailor and use as large methodology as their project and business demand according to three specific factors that determine the amount of methodology elements required to be used in a project. The first factor is the level of communication necessary among the team members. The physical location of the team, the office layout, and the personalities of the team members affect highly the communication strategy. The next factor is the presence of life-threatening implications when defects are present in the deliverables. And the last factor is the presence of corporate priorities which cause impediments to the development process [75].

7) *Feature-driven development (FDD)* is a methodology with five steps. These steps does not require extensive training from the team to adopt and use it [12]. During the first three phases the overall model of the system is being developed, the list of desired features and prioritizations are taking place into an implementation plan. The iteration for the development process take place during the fourth and fifth phase [76]. During each iteration a deliverable is produced [75]. Reprioritization of the feature list can take place when the highest priority features with the most value to the customer require reconciliation. FDD can use agile development techniques from other methodologies [75] and it is also appropriate for projects with a very large team [77].

8) *Rational Unified Process (RUP)* is a development framework that emerged when the waterfall model began to fail to deal effectively with common important problems in software projects. While, it lacks the ability to adapt change in

requirements due to well-prepared requirement design planning upfront, it ensures a high-quality product within the specified requirements and estimated schedule [78]. At one hand RUP methodology facilitates the team to deliver value earlier and on more frequent basis, at the other hand it is observed that it does not measure the project execution progress and presents limitations in stakeholder integration. Therefore the feedback required when received from customer, it is perceived as causing overhead in terms of project execution and project management [79].

9) *Kanban method* has been created as a lean tool to manage manufacturing processes and operations. It is based on lean principles. It removes the waste of the production process and improves transparency. Kanban is considered as an adaptable method that focus on cost-saving and has also been applied in software development. When changes to the scope are necessary, Kanban functions better because it focuses on limiting the work in progress, a key practice of Kanban method [80].

RQ2: *Are there any evolving hybrid methodologies and method tailoring efforts?*

An important hybrid endeavor has been addressed by Keith et al. [37]. They used concepts from the service orientation paradigm to construct their hybrid model methodology. Their work state the need for methodologies that can grow into hybrid environments as well as the need for new innovative approaches in order to embrace these practices. They follow the principles of modularity and service orientation. The focus of modularization is placed on human interaction, rather than on technical aspects. Then the project manager divides the project scope based on the technical architecture of the system. She identifies the breakpoints in terms of human interdependencies and then divides the project services appropriately. This methodology is service-oriented which does not aim in creating service-oriented software. The article [39] proposed and examined a new approach to the development and management of IT projects. Their approach integrates Scrum agile method into plan-driven traditional development process providing benefits. In the beginning, customer and the project team can specify requirements applying "Waterfall-Up-Front". Based on the requirements collected they formulate documents and bind them together as a contract. The aim is to reduce the risk of up-front ambiguities in terms of the project scope, project goals and deliverables. In the next stage of design,

implementation and unit-testing phases the project team can apply agile methods. This will accelerate the iterative thinking process and minimize the risk of rework, avoid delays and rescheduling which is usually observed in plan-driven sequential developments. When testing and acceptance should take place the team and the customer can apply "Waterfall-At-End". This will complete the build-transfer-operate (BTO) process in a formal way. Tanveer [41] proposed a combination of Agile practices and RUP best practices taken from management, communication and predictability. Agile method may have gained popularity; however they present certain weaknesses especially on complex and large scale projects. Therefore, several hybrid approaches appeared which behave more effectively when scaling is necessary. A framework ideal for phase management and control, as we have discussed in a previous section, is RUP. Similarly, Scrum defines the necessary roles, artifacts and well-defined processes. The proposed hybrid model is then constructed combining the strength of those two methodologies. It embraces seven principles and has four phases, inception, elaboration, construction, transition. During each of these phases the principles should apply. Some other characteristics of the methodology are that it gives tailoring freedom of artifacts and role adaptation according to project need. However, project size, and team size are criteria that should be considered very well before applying it in any organization. Mukhtar et al. [35] proposed another hybrid model. This model integrates Agile practices with RUP and Scrum integrating an artificial technique called case based reasoning (CBR). This AI technique assesses the information provided by the user in the form of cases and then provides the most suitable solution for improving the development life cycle. The hybrid model presents three layers: RUP layer, Integrated Scrum layer and CBR layer. RUP layer is grounded on common values of unified process and scrum layer is combined with RUP basic steps. The CBR layer has four main steps. During the first step, the most identical case is retrieved. In the next step, the knowledge, information and solution from the case are provided to find a resolution. During the third step, if a perfect match is not found the adoption and revision of the most similar case can take place. Lastly, cases are stored to help future retrievals and problem solving. The case database is updated when there is a newly learned case. It is out of scope of this literature review to explain in more detail the core functions of every phase.

Another hybrid model have been proposed by Sultana et al.[81] suitable to Pakistani industry software sector. This model embraces practices from Scrum, XP and DSDM grouping them into four categories, management practices adopted by scrum and engineering practices provided by XP. DSDM provides the testing quality assurance practices and productivity & maintenance practices. A case study showed that the proposed framework is expected to increase the productivity of the team, deliver benefits to the organization, and to the customer as well. In an earlier article, a hybrid PM approach was introduced [82] in the university R&D industry. This approach collects information and necessary skills on fundamental necessary project management practices for this specific domain.

RQ3: *Can agile tailored/hybrid methodologies be applied and adopted in different contexts other than software (e.g. services).*

As White [83] states agile project management practices became the most adapted, applied and very popular practices in IT project management. Agile practices were introduced in software development and they can stand out between a project where the probability to complete successfully is low and another, which will deliver continuous results and value quickly and consistently. Agile practices and agile thinking were firstly introduced in software development; however they were never designed not to be applied to other domains or sectors. During the literature review process, we found several articles among the 93 studies, which evidence the application of agile practices and agile thinking in different contexts. Cao et al. [84] investigate how agile practices are adapted in other contexts. Their article relies on adaptive structuration theory and examines several challenges when adopting agile methods in different contexts and how these challenges are addressed.

Levardy and Browning [85] introduced a product-based development process to manage and support project management activities. They modeled a process where project planning and project control is considered as a decision-making process. During this process, adaptive process modeling framework (APDP) simulation advise the project manager on both opportunities, which and how these iterative loops have the greatest possibility and affect project value, and risks, due to a high likelihood of iteration. Moreover, Hayata & Han [39] proposed a new hybrid approach that blends Scrum into a disciplined plan-driven environment. This proposed methodology can be applied to both IT project and software development. A recent study of Conforto [86] examined the

9. CONCLUSION

The original main objective of this literature review has always been to examine any research attention to agile practices application in non-software contexts. Further, it captured the usage and adoption of agile approaches and hybrid project management methodologies as applied mainly in software development. Moreover, the article identified generic principles that could help build an integrated hybrid approach. The review process followed the guidelines for conducting SLRs from Kitchenham & Charters [56]. Following this systematic literature review process, we analyzed 98 papers and found evidence of applying agile, hybrid methods in a different domain than software development. However, most of them described methodologies in software development. The type of articles retrieved and analyzed were empirical studies, experience reports on agile methods, hybrid and plan-driven approaches, reviews on success factors and challenges when adopting agile methods. Specific adoption and adaptation procedures have also been discussed. Other studies but very few, addressed combinations between well-known practices and tailoring efforts. In most cases scrum methodology was combined or applied into traditionally disciplined settings. This calls for more evidence in terms of frameworks applying a combination of methods in other different contexts. The findings of the review could argue that since the introduction of the Manifesto for Agile Software Development [91], the agile thinking has been adopted later on by many companies and received increased attention in academic research. Some other findings also can claim that the traditional success factors of scope, time, and cost are yet essential but no longer enough. Yet, new ways of work are being researched, promoting teamwork, customer interaction and involvement, productivity and flexibility in order to prepare organizations for the upcoming innovative advancements of tomorrow. And the project delivery will be a range of approaches—iterative, incremental, agile, predictive and whatever will come after to change the way we work [92]. The results of this systematic literature review is an input on the development of the approach that we are currently working on. This agile hybrid model in the services context will be based on specific values and cultural aspects and should aim to provide faster and more adaptive response to changing customer needs, better integration of voice-of-customer, better team communication, improve productivity and change our thinking.

AUTHORS



EMMANOUIL PAPANAKIS

MSC, is a doctoral student and researcher of the Business Administration department at the University of Macedonia, Thessaloniki, Greece. He is a certified project management specialist and since 2007 works at SPACE HELLAS SA in ICT sector as senior project manager. He holds a master's degree in media informatics from the University of Kiel (graduated in 2005) and a master's degree in banking & finance from the International Hellenic University (graduated in 2013). Mr. Papadakis's dissertation topic and research interests include project governance, hybrid agile methodologies, design thinking, agile adoption, organizational change, project portfolio and business management.



LOUKAS K. TSIRONIS

Dr. Loukas K. Tsironis is an Associate Professor of Operations Management and a member of the Business Excellence Laboratory (BEL) at the Department of Business Administration of the University of Macedonia. He received his B.Sc from Aristotelian University of Thessaloniki, Department of Forestry & Natural Environment (1993). His M.Sc. (1995) and Ph.D. (2001) from Technical University of Crete, Department of Production Engineering & Management. His research interests extended in the Operations and Supply Chain Management, Total Quality Management, Business Process Modelling and Management, on which he recently published several articles in journals and referred conferences.

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