Agile project management beyond software industry

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Abstract

Although agile-related topics are primarily discussed in IT and software related literature, ability to manage changing priorities, team productivity, customer satisfaction, effectiveness in resolving unexpected risks, as building blocks of Agile Project Management (APM), are for sure something that is desirable beyond software industry but still there is a lack of understanding and well defined instructions how to apply particular Agile in other domain. Therefore, the objective of this study is to summarize and critically examine contributions of past research and existing knowledge concerning APM applicability beyond software industry Systematic literature review (SLR) was conducted in order to obtain multiple prospective. Gaps identified in this SLR will be used to suggest areas for further investigation and to provide a framework for appropriate position of future research activities.

Key words: *project management, agile project management, software industry, non-software industry*

1. INTRODUCTION

In the last decade, the research on Agile Project Management (APM) and its adoption beyond software industry has emerged expeditiously due to the fact that projects are being more complex with uncertain outcomes and goals changing over time. Generally, todays' business environment increasingly changes in every aspect. Competition is global, opportunities are dynamic, and business processes are highly complex. These circumstances were traditionally dealt by project experts that would attempt to predetermine every possible detail prior to implementation, but modern managers are becoming aware of the relative shortcomings of traditional project-based structures to deal with the need to effect change and to take advantage of new or emerging opportunities [1]. In order to be competitive organizations are forced to recognize changes and to be more flexible when they meet them. In this context, extending agile methods beyond software community is becoming desirable response to fast-changing and challenging business environment.

2. BACKGROUND

2.1 Agile Movement and Agile Project Management

In 2001, prominent software development practitioners' convened to arrive at a consensus on how the software development industry could produce better results and overcome limitations [2] of traditional software development process in order to increase the quality, enhance flexibility and accelerate time to market. The Agile thinking is expressed in Agile Manifesto,

consisting of 12 principles and 4 values, for Agile software development and compacts the basic idea of Agile movement. The Agile values are [3]: (1) individuals and interactions over processes and tools, (2) working software over comprehensive documentation, (3) customer collaboration over contract negotiation, (4) responding to change over following a plan. The Agile principles are [3]: (1) early and continuous delivery of valuable software, (2) welcome changing requirements, agile processes harness change for the customer's competitive advantage, (3) deliver working software frequently, (4) people interaction daily (business and developers), (5) build projects around motivated individuals, (6) face-to-face communication, (7) working software is the primary measure of progress, (8) constant pace, (9) continuous attention to technical excellence and good design enhances agility, (10) simplicity, (11) self-organized teams, (12) at regular intervals, the team reflects on how to become more effective.

It is generally accepted that APM has emerged from principles and values expressed in Agile Manifesto and Highsmith [4] defines APM in terms of five key business objectives: (1) Continuous innovation — to deliver on current customer requirements, (2) Product adaptability — to deliver on future customer requirements, (3) Reduced delivery schedules — to meet market windows and improve return on investment (ROI), (4) People and process adaptability — to respond rapidly to product and business change, (5) Reliable results — to support business growth and profitability. Since Manifesto a myriad of software development methodologies and process have been created that follow these principles and are therefore considered

Agile. Two of the most known agile methodologies are extreme Programming (XP) and SCRUM. The main difference that APM bring is a shift from the traditional project-base structure with the focus on planning then executing the contents of that plan, to a focus on execution [4] with key decisions that determine the success or failure of the project being made during that execution [5].

2.2 Motivation behind research

APM was born out of the chaos and problems software development projects placed on traditional management methods. But other projects share many of the same challenges that APM has resolved in software development: turbulent environments in which changes inevitably happen at the most unwelcome time, unstable requirements that never complete, customers who don't know what they want until they see it, technology that moved faster than the project can react, nimble competitors who put the project manager in a continual catch-up mode [6]. The ideology of Agile is a good fit with the business reality of the 21st Century [7]. Traditional project management systems, which exclusively pursue the success criteria of costs, time, quality and meeting technical requirements, have become considered ineffective [8][9]. Organizations today must view their competency development challenges through one unified lens: the need to be Agile [10]. Intense industrial competition and ever changing customer requirements have led organizations to deviate from traditional project management approaches and seek for innovative alternatives [11]. Most of the literature available today refers to agile software development and although scholars and practitioners provided some valuable and essential knowledge on APM effectiveness in software industry [5][12][4][13][14][15][16][17][18][19], project management community still knows little about APM applicability beyond software development.

3. RESEARCH

Each study is inevitably limited in scope, so in order to provide an objective summary and to critically examine contributions of past research Systematic Literature Review (SLR) is used to systematically locate, assess and aggregate the outcomes from all relevant studies in a transparent way [20]. Specifying the research question is probably the most important part of SLR as it identifies the scope of SLR, guide the research protocol construction and it is the base for most critical elements of the SLR [20]. We formulated question relevant to our research objectives and important for practitioners and researchers in this field.

Research question: How is APM applied in different domains outside of software industry?

This question aims to generate evidence on agile applicability beyond software industry, available in literature. Answering to this question will help understand if and how APM is applied beyond software domain and does it translate differently into different domains.

4. FINDINGS

Our review found that a wealth of literature discusses agile related topics primarily regarding software development, but we also identified a wave of interest from researchers which proposed and investigated the application of APM in non-software projects, in variety of domains. In following, we summarized findings of prior research.

Firstly we identified a rising interests for APM application in the context of innovation and new product development in different industrial sectors. In his paper [21] conducted a pilot empirical quantitative research involving projects in manufacturing enterprises in order to determine whether these companies already use any of the agile practices and techniques, and to determine the actual contribution of different agile practices on project success. Majority of projects were divided into short iterations and regularly updated during execution with the requirements defined in an agile way. Client collaboration, on the other hand, is not expressed in these projects. The application of APM, for innovative new products suggested in [22] and [23], using a model entitled IVM2 (Iterative and Visual Project Management Method). IVM2 model consist of five components (phase and project deliverables model, project planning and controlling whiteboard, weekly activity planning whiteboard, simplified performance indicator system, open-source project management software tool for supporting the portfolio control) that are integrated into planning and controlling the projects in a simple, visual and interactive way. Application of this method in companies under investigation evidenced the benefits of using simple, iterative, visual, and agile techniques in delivering what the customer expected and provided the flexibility to deal with uncertainty in innovation efforts, reducing planning time and improving communications in combination with traditional project management best practices, such as standardization. In another research, an exploratory survey conducted within companies operating in different industrial sectors, with respect to practices and enablers related to the implementation of the APM approach to new product development projects [24]. This research recognized some of these "practices" as being dependent on the organization's environment and the project context in which they are used. Companies surveyed had some characteristics and organizational enablers similar to companies from the software industry and are experiencing the use of some agile management practices even though they do not belong to the software industry sector. Other research suggested that APM should be used in predevelopment stages of innovation as APM approach encompasses all the key processes in the predevelopment stages: idea generation, preliminary assessment, concept, opportunity evaluation, and strategy formulation and it can positively improve the effectiveness and speed [25]. Interesting research has been conducted by Carlson and Turner in 2013 and

they reviewed non-software agile case studies for applicability of agile methods to transform the aircraft systems integration process [26]. They claimed that rapid iteration and incremental testing should be embraced to reveal deficiencies early. Agile methods for aircraft systems integration promises great flexibility and innovation while reducing cost and schedule.

We are moving from innovation and product development to construction and real estate. One research founded that the iterative aspects of APM are relevant to real estate development projects. Three distinct phases can be identified in the property development process: early phase, regulation phase and implementation [27]. Different phases follow one another, but at the same time certain processes must be repeated more or less continuously throughout the entire real estate development in terms of loops - an iterative process [27]. They proposed a flexible model for managing these kinds of projects, inspired by practices in software development. In [28] authors aimed to establish and clarify the close relationships between Interface Management (IM) and APM as the emerging construction management philosophy. The APM approach is highly dependent on human collaboration as working practices of APM focus on frequent, sustainable iterative deliveries by multi-functional, intercommunicative teams. IM is proposed as a facilitator between construction and APM as it could greatly help APM achieve its desired flexibility while maintaining a coordinated and compatible project system [28]. Tomek and Kalinichuk [29] proposed potential benefits of APM in shortening construction project duration through real world concept of compressing the project schedule by running design and construction phases simultaneously with intensive investor, designers and general contractor collaboration during the process. Synthesis of the APM and Building Information Modelling in construction industry is introduced in order to use the best practical experience of both concepts [29]. BIM is proposed as a main link, facilitator that forces Agile to work out in construction industry with the full-scale output. Synthesis of the features of the two concepts bring: (1) improved understanding and implementation of project requirements, (2) improved communication and cooperation between project stakeholders, (3) improved team and project effectiveness, (4) reducing omissions and reworks, (5) reducing project time and costs. Nowotarski and Paslawski [30] investigated the possibility of using APM in SME in the construction industry based on the example of electrical subcontractor. Effectiveness and efficiency of SMEs in the construction depends of cooperation with the designer, general contractor, investor and suppliers, economically much larger partners. As a solution to most important SME problems and barriers authors proposed flexible approach in planning and implementation of a large number of orders which failed to implement by proposing a work scheduling and the ability to instantly switch between works, in case of problems and downtime. In [31] argued that there

seems to be considerable potential for gains to be made from the adoption of APM in the pre-design and design phases of construction. According to these authors iterative and incremental development can facilitate creative solutions, particularly to complex and uncertain requirements. However, the fractured and temporary nature of the actual construction organization is likely to impede the desirable continuation of these practices through to construction and support. The same is claimed by Demir and Theis [32]. In their article they pointed that a dynamic environment in design phase requires an iterative management system based on short cycles and rapid feedback loops in order to continuously arrive at the perfect solution. This requirement has resulted in the development of Agile Design Management, which is the adaptation of the Scrum approach into the design phase of construction projects. The goal of Agile Design Management is to increase coordination, interface management, collaboration and transparency throughout all design phases.

From construction we are moving to education and research. In [33] and [34] authors advocate the beneficial effects of APM in academia. Academic projects, including teaching, academic research and scholarly writing involves developing novel ideas and nonstandard products in an environment where some aspects are highly uncertain and have aspects in common with IT which makes APM a viable choice for managing activities.. Academics most frequently work in small teams where agile habits and behaviours are especially well suited. On the other side, in his paper, Kussmaul [35] describes how agile software development techniques can help improve student writing.

Aligning the principles of APM with managerial practice within university was questioned by Masson and Udas [36]. Authors founded that many components of the university including teaching, learning content, learning design, content development and management, and core infrastructure are shifting from centralized to decentralized models. Appropriateness of traditional heavy and front-loaded planning and management regimes is challenged in favour of alternative agile methods. Agile principles provide organizations with a decision-making and governance methodology for managing the discovery and deployment of open educational resources [36]. On the other hand, Grimheden [37] explored if agile methods can enhance mechatronics design education. Combining agile with mechatronics product development proved to be beneficial for students as is prepares them with a larger flexibility to handle the increased complexity in mechatronics product development and thereby enabling the project teams to deliver results faster, more reliable and with higher quality, to work in self-organizing teams and to take a greater responsibility for the overall aspects of product development.

Ruler [38] proposed Scrum as an agile planning method for public relations. Specifically this author

proposed a model (Reflective Communication Scrum) that is an expansion of the original Scrum model with some other aspects of agile philosophy in order to make it suitable for the turbulent character of public relations in the digital age. 5 elements seemed to be essential for Scram inclusion in public relations planning: permanent monitoring of change, programming of interventions in time-boxed sprints, daily team reflections in stand up meetings, adaptation of new interventions in every new sprint, self-steering teams with team responsibility, coached by a scrum master. Niemi-Grundstrom [39] argued that some of the agile methods and principles are useful in library services. These principles are: (1)

Customer satisfaction as the services are done for them, (2) Measurement of the customer services in order to improve the services further, (3) Leadership skills for agile way of working, (4) Teamwork, (5) New agile work process, simple, fast and transparent, (6) Continuous improvement and quality. In order to ensure that quality is built in services, good follow-up practices are important. Quality indicators like fast delivery, timeliness, scope, functionality and accuracy can be formulated as metrics and followed regularly.

Table 1. Benefits of Agile within different domains

Proposed domains for APM application	Benefits
APM in innovation management and product development [23] [24] [21]	• Greater flexibility while reducing cost and schedule • Flexibility to deal with uncertainty in innovation efforts • Higher effectiveness and speed in the predevelopment stages of innovation • Delivering what the customer expected • Using a plan updating approach on a timely basis • Revealing deficiencies early through iteration and incremental testing • Creating the project scope with minimal textual description • Creating the project plan collaboratively with shared responsibility • Reducing planning time and improving communications
APM in construction and real estate [28] [32] [30] [27] [31] [29]	• Improved understanding and implementation of project requirements • Improved communication and cooperation between project stakeholders • Improved team and project effectiveness • Reducing omissions and reworks • Reducing project time and costs • Quickly switch between teams on one or more of construction sites
APM in education [34] [37] [35] [36] [33]	• Conducting scientific research and writing with higher productivity and output quality • Delivering results faster • Work effectively in self-organizing small teams • Greater responsibility of team members • Team collaboration and responsiveness • Transparency and openness • Emergence and evidence-based decision making • Iterative and incremental development • Continuous and rapid feedback • Task-level management
APM in services [38] [39]	• Increased customer satisfaction • Continuous improvement and quality of services based on customer satisfaction • Permanent monitoring of change • Adaptation of new interventions in every new sprint • Simple, fast and transparent work process

5. DISSCUSION

In response to research question APM is suggested and investigated in domains such as innovation and new product development, education, services and area that is receiving a particular attention recently is construction. Various agile practices proved to be beneficial while others where just proposed in certain domains without real-life investigation. For software development, agile techniques have revolutionized the filed over the past decade, especially in uncertain or changing environments, which are just where innovation is most likely to occur [6]. So it is not surprising that APM is emerging in this field. Innovation is what agile is all about. Companies that create an

environment in which Agile flourishes find that teams can churn out innovations faster in both those categories [40]. According to [7] the winners in the rapidly changing world of manufacturing will be those firms that have mastered the agility needed to generate rapid and continuous customer-based innovation. Many companies need to retool their innovation management processes to address agility related objectives in order to survive and grow in such a rapidly changing environment. Very interesting is the fact that there is a rising interest for APM in construction and though it is characterized by a fairly considerable diversity and flexibility researchers highlighted the iterative nature of construction and real estate development. In [41] authors linked Building Project Management (BPM) to

construction project success outputs: time, cost and quality, which surprisingly showed no beneficial effect of BPM upon cost and time delivery and indicated a negative relationship between BPM and the delivered quality. These findings raise questions about the value of BPM as well as the appropriateness of the models used to measure the constructs of PM and project success [42]. Interface Management and Building Information Modelling are proposed as a facilitator between construction and APM and these inter-influences should be explored further.

Also there is a rising interest for agile in academia. Education and research work has features that parallel the reasons agile project management is needed for IT. It often has (1) an undefined scope, (2) unknown and possibly immeasurable task times, (3) an unidentified assortment of tasks featuring undiscovered task dependencies, and (4) an ever-changing resource availability for each project due to the impacts of other projects on resource needs. These factors acting in combination create a "perfect storm" that destroys the ability to use traditional project planning [34]. A simplified form of agile project management can be built around to depict much of academic work.

6. CONCLUSION

The application of agile was proposed in different domains, but in almost all cases it is based on iterative nature of projects or some particular phases which would benefit from more flexible approach in responding to changing requirements. It is obvious that APM is less common in routine operations such as maintenance; purchasing, sales calls, and accounting as no relevant research exist in these domains.

Even though this field is still in its infancy with a very few scholarly-written article, we summarized and critically examined contributions of prior research, in order to give multiple prospective concerning APM applicability beyond software industry.

Agile had its start in software development and since the inception of Agile Manifesto APM, as an innovative methodology, has been practiced in software industry,

mainly, but the application of agile methods has been extended to other fields. There is a wealth of literature and evidences about positive effects of APM in software industry; however, there is a lack of empirical studies in other types of industries and projects. Based on our literature review and theoretical observations we identified a wave of interest from researchers that discussed the application of APM and its principles and practices beyond software development projects, yet some of selected papers are based just on assumptions and ideas. There is a need to implement these ideas in real-world scenarios. If we formulate one general question-does agile methodology work for all organizations and all type of projects? Probably not. Just like with everything else, there is no one size fits all.

There are projects with different characteristics and organizations operating in various fields. This necessarily means a diversity of solution is required and each organization should reflect on its own context and projects. But introduction of agile necessitates a culture shift for organizations, since in many ways it is contrary to traditional organization, managerial structure and how traditional project management works [43]. It could be concluded that despite the growing popularity of APM in the field of software development, it has not yet been well established in domains even though this question is emerging in literature and among practitioners. The limited extant literature, up to date, is not especially empirically grounded, and not many case studies are available at the moment. But, even if it is debatable whether APM will be systematically and widely adopted, there are sufficient results, as a solid base, to believe that certain agile practices can be utilized for projects outside software domain and it is likely that APM, will have something to offer to project practitioner in more effective execution of projects when facing with certain types of projects and project scenarios. More rigorous studies are needed to be conducted before any credible advice can be given.

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