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BENEFITS OF AGILE PROJECT MANAGEMENT IN A NON-SOFTWARE DEVELOPMENT CONTEXT – A LITERATURE REVIEW

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Abstract. In the last fifteen years we have witnessed a vast spread of new methods for managing projects within software development. In 2001, the Agile Manifesto stated the common values and principles of these methods, all aimed at producing better software. Several of these values and principals are specifically expressed for designing and programming software products. Since then, the benefits of these methods have led to a widespread use of agile project management even in non-software development contexts. But, how does these values and principals affect projects in non-software areas since some values and principals are not applicable? Do they perceive the same benefits? This paper presents a systematic literature review aimed at identifying benefits in projects adopting agile methods in non-software development contexts. Out of the 21 case studies analysed, most reported projects were from manufacturing companies but even from areas such as library management and strategy management. The most frequently reported benefits were related to team work, customer interaction, productivity and flexibility. The main parts of the benefits were corresponding to the first value in the Agile Manifesto: Individuals and interactions over processes and tools.

Introduction

The methods originating in the nineties such as Scrum (Schwaber & Beedle, 2001; Schwaber, 2004) or eXtreme programming, XP, (Beck 1999) has now become famous under the term "agile project management" or "agile methods". Today, most of the agile methods have been used in the IT industry for projects within software development (Mafakheri et al. 2008; Sheffield & Lemétayer, 2013). But although *originating* in the IT industry, agile project management is now moving into other businesses. Methods spreading from one context to another are nothing new. For example, Toyota Production System (TPS), originally used for car manufacturing, later became famous under the name Lean and has now moved into all kinds of industries such as healthcare (Kim et al. 2006). Although there is extensive evidence of agile project management used in software development, there is a lack of empirical studies in other types of industries and projects. In an article by Pope-Ruark (2015, page 116) she states that "agile is not only popular in software development; a quick Google search reveals its reach in design, marketing, publishing, energy management, financial services, and civil and mechanical engineering, to name a few." That can be found by executing a Google search, but what about published articles describing actual case studies of organizations that are not within software development? This literature review is an attempt to map articles showing case studies of agile project management used in other contexts than software development.

The main research question (MRQ) for the systematic literature review is: *What are the experiences from using agile project management in a non-software development context?* In order to answer the MRQ and evaluate the results, the question has been divided into the following two specific research questions (SRQ):

SRQ1: *What benefits are experienced from using agile project management in non-software development contexts?*

SRQ2: *What challenges are experienced from using agile project management in non-software development contexts?*

Agile project management

The popularity of agile project management methods are growing and research shows an increasing amount of successful projects due to the transition into agile project management (Schatz & Abdelschafi, 2005). In a project executed with agile project management, project plans are aimed at being flexible and to allow changes even late in the process. Reoccuring reviews of the project result and retrospectives to learn from experience allow the project team to constantly decide new ways of action for the project. Follow-up does not have the purpose of comparing progress with the original plan but instead to show the actual status in the project for better decisions for the future (Schwaber, 2004). Agile project management is characterized by working in short iterative cycles with delivery of some part of the project result at the end of every cycle. In 2001, seventeen of the originators of these methods met to state what values and principles that are common for these methods. The Agile Manifesto (Beck et al. 2001) states that agile practitioners have come to value:

> *"Individuals and interactions over processes and tools*
> *Working software over comprehensive documentation*
> *Customer collaboration over contract negotiation*
> *Responding to change over following a plan."*
> *(Beck et al. 2001)*

To further explain the values of the Manifesto, it was also accompanied by twelve principles:

> *"1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.*
> *2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.*
> *3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.*
> *4. Business people and developers must work together daily throughout the project.*
> *5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.*
> *6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.*
> *7. Working software is the primary measure of progress.*
> *8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*
> *9. Continuous attention to technical excellence and good design enhances agility.*
> *10. Simplicity -- the art of maximizing the amount of work not done -- is essential.*
> *11. The best architectures, requirements, and designs emerge from self-organizing teams.*
> *12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly."*
> (Beck et al. 2001)

Since the second value of the Manifesto implies only to software development, non-software development organizations are not able to live totally according to the Agile Manifesto. Also, principles 1, 3 and 7 are directly related to a software development context.

Planning and executing the review

All searches were executed by using OneSearch which is a new type of library research system (also called a "discovery tool") available within on-line university library resources. OneSearch finds books, e-books, magazines, journals, newspaper articles, documents and publications. This includes databases such as Scopus, Business Source Premier, Inspec, Science Direct and IEEE Digital Library to name a few. The start-up of the search process by executing ad hoc searches was in order to stabilize the search strings. Especially, the start-up was used to find out the proper use of Boolean operators (NOT, AND and OR). The resulting keywords and search strings are presented

in the concept table (Table 1). The use of a concept table (Rumsey, 2008) is to start the information gathering process by defining a relevant search term (in my case: "agile project management NOT software") and thereafter define search terms that are: synonyms, broader terms, narrower terms, related terms, alternative spelling and parts of speech.

Table 1

Concept table

Concept (first search)	Agile project management NOT software
Synonyms (second search)	Agile project management NOT software NOT IT
Broader terms (third search)	Agile NOT software NOT IT
Narrower terms (fourth search)	agile AND scrum NOT software NOT IT
Related terms (fifth search)	Agile method* NOT software NOT IT
Alternative spelling	(none used)
Parts of speech	(none used)

Source:author's construction based on Rumsey's concept table (2008)

The search for literature was delimited to apply only to articles published after 2001 since that was the year for signing the Agile Manifesto. An initial selection criterion was performed against title and abstract. An article was considered relevant if, after evaluation of the title and the abstract, it contained one or several case studies that contributed to answer the main research question. The execution of all search strings yielded over 21 000 articles distributed according to Table 2. For the first iteration of the review, the first 100 results were considered of each search engine. For each article, data was extracted as presented in Table 3. The selection criteria by title and abstract narrowed the set down to 51 references whose full text was downloaded and studied in detail. The main amount of search hits not relevant for the study depended on the common use of the word "agile" not related to the investigated term "agile methods".

Table 2

Total results by search engine (with highest amount of hits)

Search phrase and number of total hits	Business Source Premier	Scopus	Science Citation Index	Inspec
Agile project management NOT software (6 173 hits)	3638	61	46	85
Agile project management NOT software NOT IT (595 hits)	135	50	28	31
Agile NOT software NOT IT (13 506 hits)	1188	1782	1037	1325
agile AND scrum NOT software NOT IT (50 hits)	1	3	3	0
Agile method* NOT software NOT IT (1136 hits)	120	74	291	0

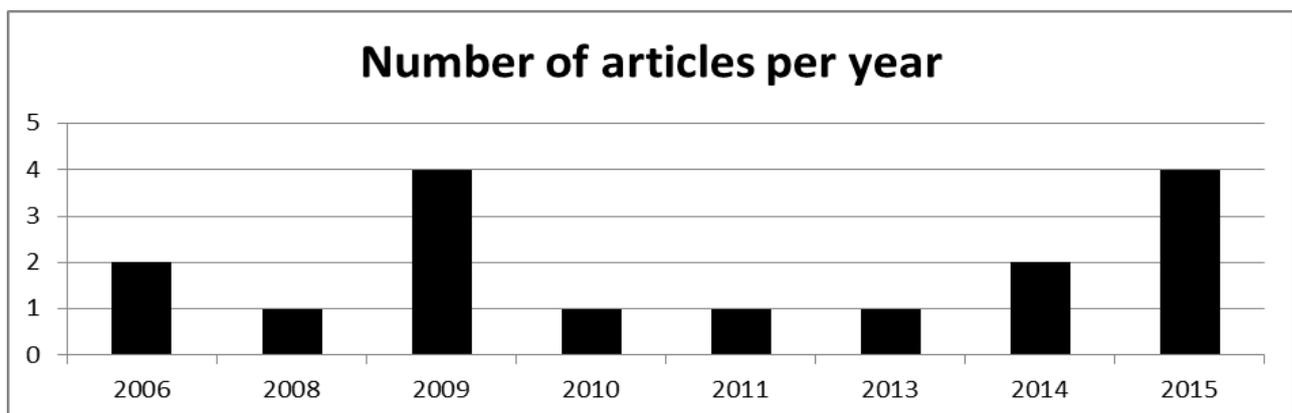*Source:author's construction based on Rumsey's concept table (2008)*

Table 3

Data extraction categories

Category	Criteria	Related to research question
Author	Author/Authors of the article	
Title	Title of the article	
Context	Within what context was the described case?	
Implementation	What parts of agile methods did they use?	
Benefits	What benefits did they experience?	SRQ1
Challenges	What challenges did they experience?	SRQ2

Source:author's construction based on research questions.

The following iterations focused on reviewing and extracting the information required in Table 3. For this purpose, an Excel sheet was designed which served as data extraction template. Each line of the excel sheet represented a relevant paper and columns represented the categories in Table 3.

In the analysis of relevancy of the case studies, an important aspect was to identify what parts of "being agile" the projects actually implemented in order to verify if the article referred to the actual agile methods apart from articles referring to the term "agile" in general. That is why implementation was an important part of the data extraction for every case. The most widespread method within the family of methods for agile project management is Scrum (VersionOne 2014). Scrum has its own language and interpretation of what was documented in the Agile Manifesto (Beck et al. 2001) and its principles. In this analysis iteration, two case studies from articles were delimited from this literature review since the information presented did not show actual agile project management implementation. Some articles presented more than one case study so, although 16 articles where finally selected, the final amount of case studies to be analysed actually became 21.

Data analysis

The number of published articles per year (figure 1) contains too few articles to make any relevant analysis regarding trends. However, it is interesting to see that there were no earlier articles found than from 2006 (since the Agile Manifesto was written already in 2001).

Source:author's construction based on analysed articles.

Fig. 1. **Number of articles per year.**

As explained earlier, in some articles there was more than one case study described. Therefore, a total of 21 case studies (from 16 articles) have been analysed and detailed in Table 4.

Table 4

Details of the analyzed case studies

Authors (year the article was published)	Context (type of project if applicable)	What "parts" of agile ways of working did they describe as implemented?	Reported benefits
Andersson et al. (2006)	Supply chain management/manufacturing	Short sprints, daily stand-up meetings and a PO team.	Increased productivity, speed and quality.
Denning, S. (2015)	Top-level management, strategic work	Customer value-focus, self-organizing teams, short sprints and visual transparency.	Transparency and collaboration in the team, increased customer interaction, productivity, quality and speed.
Edin Grimheden, M. (2013)	Education, course development project	Not described.	Flexibility, quality, focus, knowledge sharing and coping with change.
Gangjun et al. (2009)	Industrial design	Iterative planning, iterative evaluation and iterative tracking.	Productivity, speed, flexibility, knowledge sharing and coping with change
Gangjun et al. (2010)	Industrial design (product development projects)	Demand management, iterative planning, iterative evaluation and iterative tracking.	Productivity, speed and knowledge sharing
Molhanec, M. (2008)	Product design, packaging and electronics	Iterations and reviews.	Not specifically described in the article.
Molhanec, M. (2009)	Product design, packaging and electronics	Iterations and reviews.	Not specifically described in the article.
Niemi-Grundström, M. (2014)	Library management	Not specifically described in the article.	Collaboration, productivity, speed, flexibility, quality (tasks/goals/req.).
Pope-Ruark, R. (2015)	Higher Education (course development project)	Short sprints, scrum board, daily stand-ups, sprint planning, review and retrospectives.	Collaboration in the team, Better understanding of goals/tasks/req. and clear sense of progress.
Quaglia et al. (2011)	Simulation modelling in electronics factory	Defined backlog, spring planning, 1-2 week sprints and customer reviews.	Collaboration in the team, understanding of goals/tasks/req., increased customer interaction, priority process.
Sommer et al. (2015)	Manufacturing, Pharmaceuticals	Scrum boards, burn-down chart, daily Scrum, product backlog and value-chain model.	Collaboration in the team, understanding of goals/tasks, Increased customer interaction, knowledge sharing and resource allocation.
Sommer et al. (2015)	Manufacturing, Toys	Scrum boards, burn-down chart, daily Scrum, product backlog and work packages.	Collaboration in the team, task/goals/req work, transparency priority and autonomy.
Sommer et al. (2015)	Manufacturing, Electronics	Scrum boards, burn-down chart, daily Scrum and product backlog.	Collaboration in the team, increased customer interaction, productivity, speed, flexibility and motivation (less complaints).
Sommer et al. (2015)	Manufacturing, Windows	Scrum boards, burn-down chart, weekly Scrum, product backlog and value-chain model.	Collaboration in the team, increased customer interaction, priority process and collaboration.
Sommer et al. (2015)	Manufacturing, Power cables	Scrum boards, burn-down chart, daily Scrum, product backlog and work packages.	Collaboration in the team, increased customer interaction, collaboration and motivation.
Sutherland, Altman (2009)	Management, strategy, in-house consultancy	Scrum principles and one-week sprints.	Interaction, understanding of goals/tasks/req., transparency, impediment removal process.
Sutherland, Altman (2009)	Management, strategy, in-house consultancy	Scrum principles and one-week sprints.	Productivity, speed, transparency and individual autonomy.
Sutherland et al. (2009)	Non-profit (internal change project)	Scrum principles.	Collaboration, transparency, focus and coping with change and impediments.
Tolf et al. (2015)	Health care, hospital management	Not specifically described in the article.	Flexibility and motivation, coping with change and priority process.
Van Ruler, B. (2014)	Public relations	Scrum principles.	Increased flexibility and coping with change.
Wainer, M. (2006)	Higher Education (course development project)	Scrum roles, short sprints, review, and retrospective.	Collaboration and focus in the team, increased customer interaction, productivity, quality and speed.

Source:author's construction based on analysed articles.

The name of the articles can be found in the reference list at the end of this article. The reported implemented "parts" (values, principles or practices) of agile ways of working in the different case studies shows what the authors put forward as implemented agile elements. A problem in completing the analysis has been that some case studies refer to the Agile Manifesto (and its principles) while others refer to Scrum and its terminology. This cause problems in analysing what parts of agile methodology the organizations implemented since the terminology as well as level of detail differed.

SRQ1: What benefits are experienced from using agile project management in non-software development contexts?
The above presented Table 4 contained a detailed description of the different case studies and reported benefits. Table 5 presents the 17 reported benefits and number of occurrences in total identified by the systematic review.

Table 5

Reported benefits from the case studies

Number of occurences	#	Reported benefits
11	1	Better collaboration in the team
9	2	Increased customer interaction
8	3	Increased productivity and speed
7	4	Increased flexibility , coping with change
6	5	Better understanding of goals/tasks/requirements
6	6	Increased transparency and visibility
5	7	Increased quality
5	8	Customer-centered value-add priority process
4	9	Increased knowledge sharing
3	10	Increased cross-organizational collaboration
3	11	Better focus
2	12	Impediment removal process
2	13	Increased individual autonomy
2	14	Decreased customer complaints
2	15	Increased motivation
1	16	Clear sense of progress
1	17	Improved resource allocation

Source:author's construction based on identified benefits in the analysed articles.

Table 5 shows that the most reported benefits are related to team work, customer interaction, productivity and flexibility. Some of the reported benefits are concepts that are not explicitly stated in the agile manifesto, such as the impediment removal process or better focus.

SRQ2: What challenges are experienced from using agile project management in non-software development contexts?

Table 6 shows 11 challenges identified by the systematic review. Although with very few references to challenges, the most reported challenges were problems in changing mindset to allow flexibility, lack of process visibility and buy-in from managers.

Table 6

Reported challenges from the case studies

Number of references	Reported challenges
3	Changing mindset to allow flexibility
3	Lack of process visibility
2	Buy-in from managers
2	Difficult to see benefits early in the project
2	Inadequate knowledge sharing
2	Individual work, lack of communication
2	Long-term planning
1	Lack of stakeholder engagement
1	Scope creep
1	Insufficient resource allocation
1	Redundant work

Source:author's construction based on identified challenges in the analysed articles.

Interpretation of the results

Regarding SRQ1: *What benefits are experienced from using agile project management in non-software development contexts?* To get a better overall view of the reported benefits, table 7 was constructed to show what benefits that correlates to specific values of the agile manifesto. The number after each reported benefit shows list placement in table 5 (which was organized based on number of references).

Table 7

Values of the agile manifesto and corresponding benefits

Value from the agile manifesto	Corresponding reported benefit
Individuals and interactions over processes and tools	Better collaboration in the team, 1 Increased transparency and visibility, 6 Increased knowledge sharing, 9 Better focus, 11 Impediment removal process, 12 Increased individual autonomy, 13 Increased motivation, 15 Clear sense of progress, 16 Improved resource allocation, 17
Working software over comprehensive documentation	Increased productivity and speed, 3 Increased quality, 7

Customer collaboration over contract negotiation	Increased customer interaktion, 2
	Better understanding of goals/tasks/requirements, 5
	Customer-centered value-add priority process, 8
	Increased cross-organizational collaboration, 10
	Decreased customer complaints, 14
Responding to change over following a plan.	Increased flexibility , coping with change, 4

Source:author's construction based on identified benefits compared to values of the Agile Manifesto ((Beck et al. 2001).

A look at the reported benefits in table 7 shows that the highest amount of benefits corresponds to the first value of the Agile manifesto "Individuals and interactions over processes and tools". The second highest amount of benefits corresponds to the third value: "Customer collaboration over contract negotiation". The second and fourth value of the agile manifesto corresponds only to three of the reported benefits, together.

Regarding SRQ2: *What challenges are experienced from using agile project management in non-software development contexts?* As earlier reported, the most reported challenges were related to changing mindset to allow flexibility, lack of process visibility and buy-in from managers. However, very few case studies actually reported specific challenges from their projects. Rather than presenting challenges, the differences in strength of each benefit was mostly highlighted.

Limitations

Typical threats in systematic literature review studies come from misclassifying by the researcher, a bias in the selection of articles or inaccuracy in the extraction of data. These issues have been addressed in this study. To deal with the risk of misclassification, a control mechanism was introduced where some papers have been reviewed by other colleague researcher at the Karlstad university. The selection of papers was mainly limited by the available research resources, limiting the review to the top 100 results from each search engine. Finally, with regards to data extraction, the articles were frequently discussed among fellow researchers.

Conclusions

As this research work has shown, there is a vast interest for using agile project management in areas not even close to software development. Several articles were identified that showed successful case studies were agile project management had been applied. Nevertheless, these are initial results and more research is needed to better generalize and build on their success.

The main benefits reported from case studies in a non-software development context were related to team work, customer interaction, productivity and flexibility. Some of the reported benefits are concepts that are not explicitly stated in the agile manifesto or the accompanying principles, such as the impediment removal process or better focus. Also the highest amount of benefits corresponds to the first value of the Agile manifesto "Individuals and interactions over processes and tools".

These findings are interesting for further research since they imply that the first value of the agile manifesto could have the largest impact on benefits in agile applications in non-software development contexts. Further research needs to be carried out in order to make that kind of conclusions, however.

As noted, very few challenges have been reported (and sometimes only differences in strength of each benefit). Is it possible that there are so few challenges in agile implementations or could the authors have been biased when studying the cases so that they did not investigate challenges enough? Or could it be that the selected cases for this study, only 21, were not representative for the experiences from implementing agile in general? Even here, further research is needed to make any kind of conclusions regarding reasons for the absence of reported challenges.

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