Systematic review on evaluating planning process in agile development methods

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ABSTRACT

Agile development methods have been catering the need of faster delivery of the ever-demanding domain of software engineering. These methods are able to deliver value to users and businesses via fast, reliable, and repeatable process. Planning requirements and processes takes the driving seat in a dynamic environment because the value proposition rapidly changes. This paper exhibits a systematic literature review of planning processes implemented by various agile methods in order to find the best suited agile method in terms of robust planning. It was found that Scrum is the best suited agile method for planning processes.

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1. INTRODUCTION

Agile is a software development approach in which requirements and solutions evolve through the collaborative effort of small cross-functional teams and their customers (end users). These team are self-organized to the major extent and perform adaptive planning and development to achieve early delivery [1]. The focus is on flexible and quick response to change. There are various agile development methods available designed to for different circumstances. Some focus on the practices while other focus on managing the work flows. Some deals better with requirements specification and development whereas some seek to cover the full development life cycle.

Apart from figuring out how the product would be made; agile planning also helps the software team in measuring and converting the user stories into production ready software. The task list of an agile project is termed as Master Story List. It contains all requirements that customers want in their required software. The conversion speed of user stories into a software is termed as team velocity. This team velocity is used for calculating team's productivity and for setting timelines and commitments [2]. Every agile methodology or may be a combination of these, requires a bird view to plan every phase that the team would be facing. This planning also helps in making commitments, resource planning and allocation [3].

The paper presents a systematic literature review (SLR) of various agile development methods in context of planning process. Section 2 presents the methodology which includes development of research questions as well. In section 3, we discuss various agile development methods with respect to planning processes. Section 4, concludes the paper.

2. RESEARCH METHODS

In our research, we have used systematic review to analyse the current studies, findings and comparing the results. In this review, we have collected and analysed data through multiple existing research papers and studies. We have formulated multiple research questions and have made findings to answer those. Table 1 list the final selection of previous studies analysed in this work.

Table 1. Related studies analysed in the study

ID	Referred Authors	Reference	Agile Methods	Research Date
S1	Traa, Johan WA	[4]	RUP, MSF	2006
S2	Peka, Abrahamsson, Juhani Warsta, Mikko T. Siponen and Jussi Ronkainen	[5]	ASD, Crystal, DSDM, XP, FDD, Scrum, AM, ISD and PP	2003
S3	Kniberg, Henrik	[6]	XP, LEAN, FDD, Crystal, ASD, Scrum, DSDM	2015
S4	Achim Kampker, Alexander Mecknborg, Peter Burggraf and Thomas Netz	[7]	N/A	2013
S5	Gul Ahmed, Tariq Rahim and Nawaz Brohi	[8]	XP, Scrum, RUP	2014
S6	J. Highsmith	[9]	XP, Crystal, Scrum, DSDM, LEAN, ASD, FDD	2002
S7	M. Minarik	[10]	Scrum	2004
S8	D. Waddell and A. Sohal	[11]	N/A	1998
S9	F. Neal and R. Vaclav	[12]	N/A	2007
S10	Gurpreet Singh Matharu, Anju Mishra, Harmeet Singh and Priynka Upadhyay	[13]	XP, Scrum, Kanban	2015
S11	Joao M. and M. Alemeida	[14]	XP, Scrum	2010
S12	Faiza Anwer, Shabib Aftab, Syed Shah Muhammad Shah and Usman Waheed	[15]	XP, Scrum	2017
S13	G. Wagenaar, Sietse Overbeek, Garm Lucassen, Sjaak Brinkkemper and Kurt Schneider	[16]	N/A	2018
S14	T. S. Mendes, Mario Andre de F. Farias, M. Mendonca, H. F. Soares, M. Kalinowski and R. O. Spinola	[17]	N/A	2016
S15	Myklebust, Thor, T. Stalhane, G. K. Hanssen, T. Wein and B. Haugset	[18]	Scrum	2014
S16	Kanwal, Faria, K. Bashir, and A Haider Ali	[19]	N/A	2014
S17	Stettina, Christoph Johann and Egbert Kroon	[20]	N/A	2013
S18	Stettina, Christoph Johann and Egbert Kroon	[21]	N/A	2011
S19	S. Merzouk, S. Elhadi, H. Ennaji, Abdelaziz Marzak and Nawal Sael	[22]	XP, Scrum, DSDM, FDD, Kanban, Crystal, ASD	2017
S20	Shelly	[23]	XP, Scrum, DSDM, FDD, ASD	2015
S21	P. Abrahamsson, O. Salo, J. Ronkainen and J. Warsta	[24]	Scrum, RUP, ASD, Crystal	2002
S22	Ow, Siew	[25]	Scrum	2009
S23	G. Papadopoulous	[26]	N/A	2015
S24	R. Hoda, N. Salleh and J. Grundy	[27]	N/A	2018
S25	A Lozez-Alcarria, A. Olvares-Vicente and F. Poza-Vilches	[28]	Scrum, Kanban	2019

2.1. Objectives of the study

The study has two objectives:

-To review planning processes and requirements in various agile development methods

-To identify best agile development method(s) with respect to planning process.

2.2. Research questions

The research questions are mandatory to develop a base for SLR. We have extracted some research questions that will be answered in this research. The findings and results of this study will be based on these questions which are given in the Table 2.

Table 2. Research questions of the study

Research Questions	Motivation
RQ1: What are the objectives of planning in various Agile methods?	To identify the different objectives of planning phase and their impact on overall delivery.
RQ2: When planning is performed in various Agile methods?	To identify when the planning should be done. Is it a onetime or continuous activity.
RQ3: How the documented outcome of planning is different in various Agile methods?	To identify the documented outcome of the planning so that validation can be achieved.

2.3. Search strategies

To get the maximum relevant studies, we used a search strategy [29-31]. Search strategies are ways of using search terms in terms of finding required information from search tools, such as search engines, the library catalogue and online databases. This strategy consists of the following components.

2.3.1. Search method

ScienceDirect, IEEE Explore, SpringerLink, Scopus, Wiley Online Library and ACM Digital Library were searched manually to extract the relevant existing studies. To achieve good serach results, it is necessary to use search strategies. Some of our common serach startegies are parenthesis, phrase searching, truncation, wildcards, and field searching.

2.3.2. Search terms

In our study, the search terms have been made through the blend out of primary terms that are utilized in the subject of the exploration and all the applicable terms and catchphrases. We have searched keywords as "planning in", concatenated with the agile process name. Not only this but we used question-type keywords too. We have also used the names of planning phases of the agile methodologies to get accurate and crystal-clear results. Some examples include:

- Planning in extreme programming.
- How to plan using Scrum?
- Sprint planning meeting.
- Planning poker.
- Crystal focus phase.
- ASD speculation phase.

2.3.3. Data sources

The research sources are found through oxford press, IEEE and multiple international journals, Google Scholars and ResearchGate. We ensure that no counterfeit sources are used in our study. Figure 1 demonstrate the type of study, we used in our study. We excluded the studies which are not directly or indirectly relevant to our research topic. The rejection of research papers depended on moral standards and to check whether the focused study is going along to the catchphrases, parameters, and phrasings that are significant to this exploration. The studies were excluded from our study when:

- Unverified or unauthentic web links.
- Papers have weak evidences.
- Weak and outdated references.
- Non-perceived conferences.
- Obscure authors.

2.3.4. Inclusion and exclusion criteria

To identify the relevant studies, inclusion criteria is used. It is the qualification criteria for any journal article or research paper to incorporate into this exploration. Incorporation criteria must react to the targets of the study. Many existing studies were reviewed and explored for relevant and useful data which ranges from conferences, websites, books and articles. The study material research papers were included when:

- Authentic and official websites.
- Each article or paper had matching research parameters and keywords.
- Studies by authentic and known authors.

Study selection

Figure 2 demonstrates no. of studies included by each stage of our SLR. The filtering of papers were done by inclusion/exclusion criteria by the following way:

- Phase 0: 3198 relevant papers were found by searching string on six digital aforementioned libraries.
- Phase 1: We selected 408 papers by this phase. In this phase, we read the title and keywords of the papers and filtered the selection. If there was any doubt regarding the retrieved papers, we transferred the doubtful papers to next selection round for another in-depth investigation as it was impossible to analyse the papers by reading keywords and titles.
- Phase 2: The abstracts and conclusions of the selected studies were analysed to make sure that all were relevant to our SLR's objective. The selected papers count went to 150 when we applied the inclusion and exclusion criteria on the abstracts and results of the included papers.
- Phase 3: The final selection round, includes the reading of full text of the included studies by second phase. A paper was included in our SLR if it met all inclusion criteria. Papers, that were less than 6 pages, or papers

whose complete texts were unavailable due to limited access or irrelevant papers were excluded. Furthermore, the quality of studies was also analysed to exclude low quality papers due to reputation venues etc.

Finally, 25 papers were selected by this last phase. A critical piece of the study inclusion, data extraction and synthesis phases have been done by the first author. In every phase, we recorded the reasons of incorporation or prohibition choice for every one of the papers. These reasons were then used for reassessmen and discussion with other authors to determine if a paper should be incorporated or not. A double-check, which used a random number of included papers for every step was done by the second author

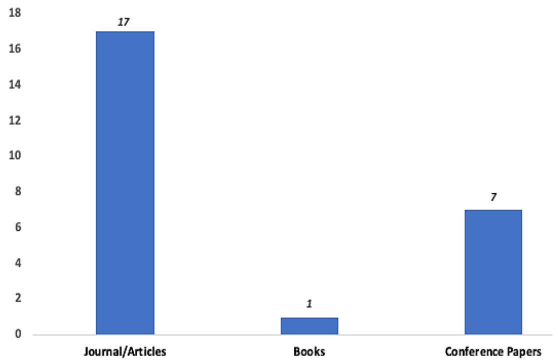

Figure 1. Types of various data sources

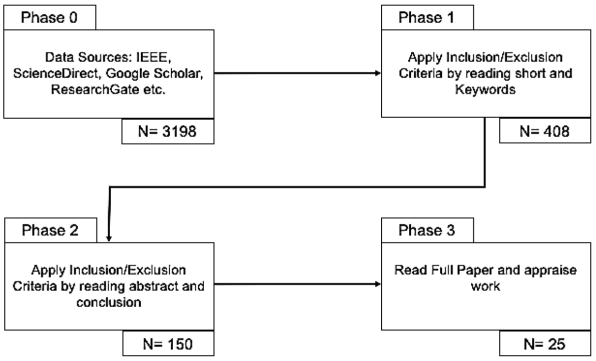
Phase 0
Data Sources: IEEE, ScienceDirect, Google Scholar, ResearchGate etc.
N= 3198
Phase 1
Apply Inclusion/Exclusion Criteria by reading short and Keywords
N= 408
Phase 2
Apply Inclusion/Exclusion Criteria by reading abstract and conclusion
N= 150
Phase 3
Read Full Paper and appraise work
N= 25

Figure 2. Phase of the search process

2.3.5. Data extraction and synthesis

The relevant information was extracted from the selected papers. This information is based on data items that would help in answering the SLR's research questions. The separated data was put away in MS Excel Spreadsheet for further investigation.

Descriptive Analysis was used to analyse the data items, mentioned in Table 3. In order to identify the agile method in the selected papers, we used data item D5. Five steps of thematic analysis [32-35] was followed as detailed below:

- Familiarizing with data: we endeavored to peruse and analyse the extricated research types to shape the underlying thoughts for analysis.
- Generating initial codes: in the second step we extricated agile techniques from each paper. It ought to be noticed that now and again, we needed to recheck the papers.
- Searching for themes: for every data item, we endeavored to consolidate diverse starting codes produced from the second step into potential themes.
- Reviewing and refining themes: the research type and agile methods from 3rd step was verified against each other to acknowledge what themes had to be consolidated with others or excluded (e.g., lack of enough evidence).
- Defining and naming themes: through this step, we characterized clear and compact names for each exploration type.

Table 3. Related studies in the work

#	Data Item	Description	RQs
D1	Author(s)	The author(s) of the paper	Demograpic Data
D2	Year	The year of the publication of the paper	Demograpic Data
D3	Title	The Title of the Paper	Demographic Data
D4	Publication Type	The type of publication (e.g. journal paper)	Demograpic Data
D5	Agile Methodology	The agile methodology focused in the paper	Demograpic Data
D6	Objectives of planning in various Agile methods		RQ1
D7	Time of planning in various Agile method		RQ2
D8	Documented outcome of planning in various Agile methods		RQ3

2.3.6. Results

We highlight the results, extracted from the aforementioned activities in the following subsections. These results do have some minimal interpretations of us which we will reflect in the discussions section. Here, we are only mentioning demographic and research design attributes information: studies distribution, research types, study context and data analysis type.

Studies distribution

One of the key aspects of the information sources in SLR is the demographic information. When new researchers take up the task of conducting research on a particular topic, it serves as vital information and therefore citing information on the types and venues of research papers under review is very helpful. In Figure 3 there is a summary of 25 papers published from 1998 to 2019, as they are distributed along the year.

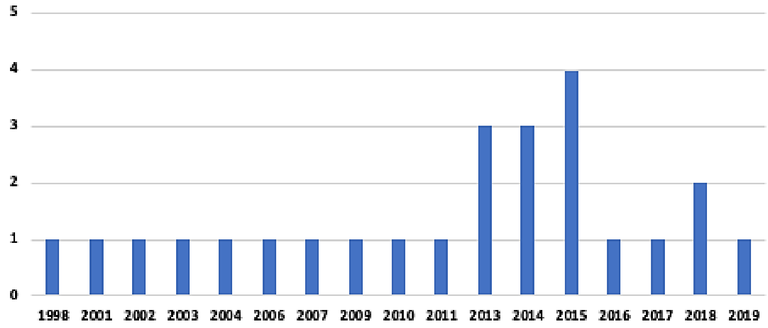

Figure 3. Number of selected studies published per year

3. PLANNING IN AGILE DEVELOPMENT METHODS

By agile planning, we calculate estimates and resources that would be required for the software project. The Planning phase helps the development team and stakeholders to discover unidentified risks what could arise during software project development, deployment and maintenance. This phase can also be made iterative to plan in detail of smaller tasks.

3.1. RQ1: planning objectives of agile methods

The planning phase of different agile methods can have different goals but they are only successful if they are clear and focused. XP planning focuses on product in delivery. LEAN planning clarifies confusions. Sprint planning produces sprint backlog and resource allocation. Crystal planning emphasizes on goal definition and individual tasks. FDD is for drafting and allocating initial schedules and responsibilities. DSDM focuses on outline planning of far off phases and detailed planning of the next phase. MSF produces Product vision and acceptances tests. ASD helps realize the uncertainties in complex problems. AUP addresses risk factices and constructs validates the system architecture.

3.2. RQ2: when to plan in agile methods

A plan can be succeeded when it is initiated at the right time. XP plan must be done once an iteration. LEAN plan must be done when taking any decision. Scrum plan must be done at the start of any sprint. Crystal planning requires to be done before goals defining & task allocation. FDD planning must be done after building feature list. DSDM planning must be done with timeline scheduling. MSF requires planning to be done after vision & scope approved. In AUP, planning is done before construction phase and in ASD, it is difficult to speculate without collaborating/learning or to collaborate/learn without speculating.

In all agile Methodologies, planning must be initiated right after the requirements have been gathered, analysed and explained to the development team. This is needful for allocation of resources and scheduling of timelines. LEAN, helps in clarifying ambiguous situations by suggesting to plan before any decision making. Alike LEAN, ASD methodology also does not have any fixed phase of planning as it suggests to explore any hypothesis first.

3.3. RQ3: planning outcomes of agile methods

We get different types of documents/business models when using different agile methodologies from planning phase. Using XP, we get user story cards, task cards. LEAN provides a LEAN plan. Scrum provides sprint backlog. Crystal planning gives us frequent delivery plan. We get feature sets, class diagram by FDD planning. DSDM planning provides us outline prototyping plan. MSF planning gives us master project plan, risk exposure rating form. By AUP planning, we get interface prototypes, project plan, use cases, class/package diagrams and ASD planning provides us with outline plan, delivery plan.

We obtain a "plan" by every agile methodology's planning phase. This output helps the development team from resource allocating to maintenance phase of the software. We also get visual models with the plan, which demonstrates the construction and delivery plans. These include prototypes, UML diagrams. Scrum provides us a product backlog which lists the tasks that would be delivered at the end of that sprint. The overall review of the planning process in agile methods is given in Table 4.

Table 4. Consolidation of planning in agile methods

Agile Methods	Planning Goals	Time of Planning	Planning Outcomes
XP	Guide product in delivery	Once an iteration	User story cards, task cards
Lean	Clarrifying confusing situations	When taking any decision	Lean Plan
Scrum	Details, sprint backlog production, resource allocation	Start of aprint	Sprint backlog
Crystal	Focusing on initial task and allocation of goals	Before goals defining and task allocation	Frequent Delivery plan
FDD	Constructing initial schedules and assigning initial responsibilities	After building feature list	Feature sets, Class Diagram
DSDM	Plan in detail for the next phase and to plan in outline for the phase that are further away	Timeline scheduling	Outline Prototyping Plan
MSF	Product vision is met through the requirements and the acceptance tests are developed	After vision and Scope approved	Master project plan, Risk Exposure Rating Form
AUP	Address known risk factors and to establish and validate the system architecture	Before construction phase	Interface prototypes, Project Plan, Use cases, Class/Package Diagrams
ASD	Acknowledgements the reality of uncertinity in complex problems	It is difficult to Speculate without collaborating/ learning and vice versa	Outline plan, Delivery plan

As per our analysis of the various agile methodologies, Scrum seems to be the best option for planning:

- The product owner creates a wishlist of high- priority tasks as per business values, which is proposed as a product backlog.
- Scrum teams plan a sprint planning session where the wishlist is broken down into smaller more manageable tasks
- The Scrum team produces and plans the implementation of the sprint backlog
- The team decides the sprint's time duration (usually two weeks long)
- Daily standup meetings are held to discuss bottlenecks, status of previous tasks and tasks due before the next meeting
- The Scrum master guides, facilitates, motivates and brings focus to the team
- Product owner reviews tasks at the end of sprint

4. CONCLUSION

These studies has compared and examined various agile methodologies in the context of the planning processes under two objectives. One is to review planning processes and requirements in different agile development methods and the second objective is to find out the best agile development method(s) with respect to planning processes. In our findings, Scrum is the best option among various agile methods within the domain of planning requirements and processes.

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