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Agile Movement from IT Industry to Non-IT Industry: A Review and Analysis

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Abstract—

Software engineering is comparatively a new addition in the vocabulary of traditional engineering discipline. Being a late joiner, software engineering obtained many of its process foundation from traditional engineering domains. But the ever-changing business needs and the growing complexity that are required to be addressed in a software application, have kept software engineers on their toes to continuously improve the development process to meet and to manage the challenges in it. Agile project management has been the most significant development in IT industry to manage software development process that could deliver quality software product at an extremely high speed compared to any of the predecessor methods. The key abstraction of all the flavors of agile methods is adaptability towards change. This adaptability is achieved by the use of quality practices and practitioners in a closely integrated working environment that also involves the customers in the development process more than ever before. IT industry has acknowledged the significant success of the agile process and has been a buzz-word for a decade in the IT industry. The paper is built upon a comparative study of the application of Agile project management in both IT and non-IT industries. It further discusses the adaptability of agile methods and its potential to benefit the Non-IT industry in managing the quality of deliverables while maintaining high delivery speed. The discussion extends its boundaries to cover the reason for less acceptance of Agile process in non-IT industry and put forth an argument against the suitability of some of the success-factors in the case of non-IT industries, while they enabled a high acceptance of the Agile process in IT-industry.

Keywords-- Agile process, Agile project management, Agile success-factors, Agile in IT-Industry, Agile in Non-It-Industry, Agile Manifesto, Chasm

I. INTRODUCTION

A conference held in August 1996 to pen-down the history of software Engineering and computer science as a whole as one of the engineering disciplines suggested Software Engineering at that time as being in a pre-engineering phase similar in many respects to the pre-engineering phases of the traditional engineering disciplines [1]. Although, it has been two decades since then and software engineering has matured itself and could no longer be described in pre-engineering phase but relatively software engineering is still a newcomer in the group of traditional engineering disciplines. The software engineering is an important placeholder in the engineering domain since fifty years. Software development since its inception remained a complicated thing that largely depends on "code and fix" which makes it a mess. Due to the lack of proper planning because of subtle differences in the requirement in every piece of software that developers write, the design of the system remained a matter of instability and keeps changing with the gain of clarity of what the developer is building as opposed to the initial perception of it. This worked for applications that are small in size but as the application starts growing, it became more and more difficult to keep adding new functionalities and bugs remained a nightmare to fix. The fixes itself often break other numerous working functionalities. This continued for a long period until an alternative was introduced that is 'Methodology'. Methodologies are introduced as a much-disciplined process controlling software development with all good intentions to make software development predictable and efficient than before [2]. Software processes soon defined the baselines with the methods and technologies used to evaluate, support, execute and improve software development activities. The early contribution was made by Royce's 1970 paper which is often credited to be the paper which defined the stage wise "waterfall" model of the software process leading a formal way towards managing software projects [3]. In very short span of time software engineering discipline has witnessed the dramatic evolution of a number of processes specifications which kept on improving the way software projects were managed in IT industry. There were advantages and disadvantages associated with each process with each new model attempting to remove the disadvantages of the previous models. In the similar line, a recent trend in last decade has shifted towards agile process and various flavors of agile process are prescribed which the IT industry has embraced and has witnessed remarkable improvement in the quality and the economy of the application development along with the ever changing business needs, especially in the enterprise application development process which constitutes the majority of all the applications development effort, globally to run complicated business.

II. WHAT AGILE HAS DELIVERED TO IT PROJECTS?

Agility largely depends on three basic dimensions in general namely: Aggressiveness, innovations, and Flexibility to sum up and is driven by a less clear initial vision of the product along with the unstable business

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environment. We begin with the well-known Standish group report which is highly referred by many IT process engineering groups presents the failure, success and challenged project percentage for software projects and are 24%,16%, and 58% respectively for traditional waterfall development approach. Whereas survey presents the same figures for Agile development approach to be 14%, 41% and 48% for failed projects, successful projects, and challenged projects. The survey further concludes that more and more clients are favoring Agile way due to the benefits of deliveries like low defect rate, continuous and valuable development with well-defined visibility and time to market demands on top of all[4]

Another survey that was conducted by Scott Ambler in the year 2008, 2010 and 2011 also report an increasing adaptability of the IT-Industry for Agile implementation in general due to consistently improved the success rate.

Research Question: *Can Agile deliver the same impact for non-IT projects?*

To answer this question we break down the further discussion under following topics

- Understanding success-factors in IT-projects for Agile implementation
- Analyze the success-factors to understand their fitness with non-IT projects.
- Identify the gaps with and its justification.

The Figure 1, below illustrates the three dimensions of decision criteria that form the bottom line for this work.

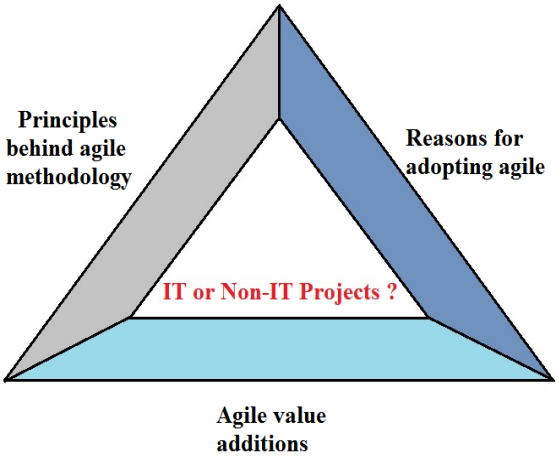

Figure 1: Dimensions of decision criteria.

III. SUCCESS-FACTORS FOR IT-PROJECT IN AGILE IMPLEMENTATION

Success-factors are the favoring conditions in the context to the nature of IT-Industry that has resulted in Agile to become a well-recognized choice for project management. In order to compare IT-projects with non-IT-projects to decide upon the fitness of Agile project management approach, for non-IT projects, we discuss here the three sets of success-factors. These three sets of success-factors are closely related and are not only the underlying foundation but also complements each other to make Agile a success for IT projects.

The three sets of success-factors are

- Principles behind Agile methodology
- Agile value additions
- Reasons for adopting Agile

A. Principals behind Agile methodology

With software development methodologies keep losing its credibility to simplify the development process and to achieve great success rate for projects in IT-Industry, in the mid of February 2001, seventeen discrete minded software practitioners joined to write the Agile Manifesto.

The Agile manifesto was not ‘anti-methodology’ but was actually intended to get back the credibility of ‘methodology’. While they did not agree on the much common ground, however, a consensus was derived from some key value. [5]. The summarization is visually presented in a single snapshot in the figure 2.

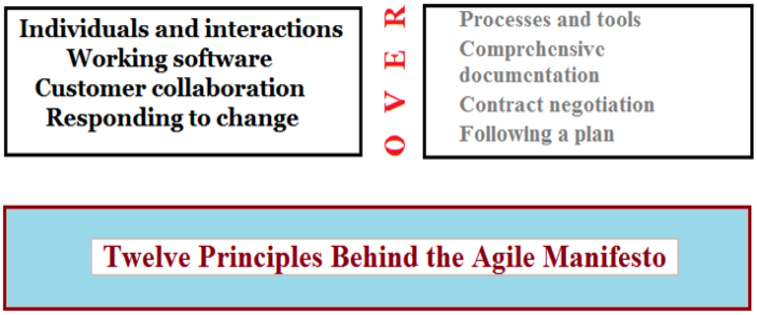

Figure 2: Agile manifesto snap shot.

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These four values derived based on twelve principles also known as Agile Manifesto principles are shown in top-left box in figure 2. So these four phrases are the agile adoptions and phrases on the right side are underlying success beliefs of the other existing processes. These four values soon become an important set of success-factors of the Agile project management because they were able to distinguish themselves as the base line of the process simplification to become an important tool in the Agile tool-box.

B. Agile Value Additions:

As shown in the graph in figure 3. The cost of change for Agile development process displays a lesser tendency to sharp rise after mid-development whereas, the cost of the change shows a steep rise after mid-development for the non-agile process [6].

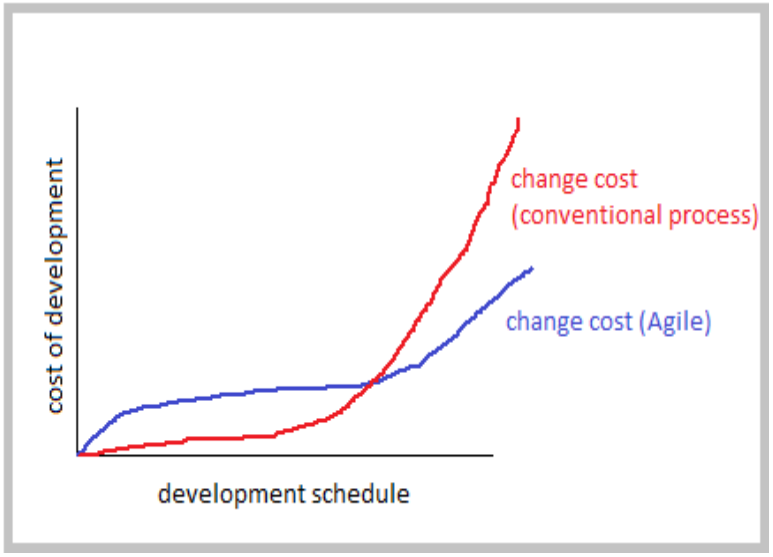

Figure 3: Change cost comparison.

It was also found that time spent in finding the defects, fixing the defects, testing and deploying to the production incur more cost in the traditional development process. It also shows a steep increase in overall cost in traditional development process whereas, in the following Agile process, most of the defects were found and corrected earlier because of constant customer involvement of the working parts, as depicted in figure 4. [6]

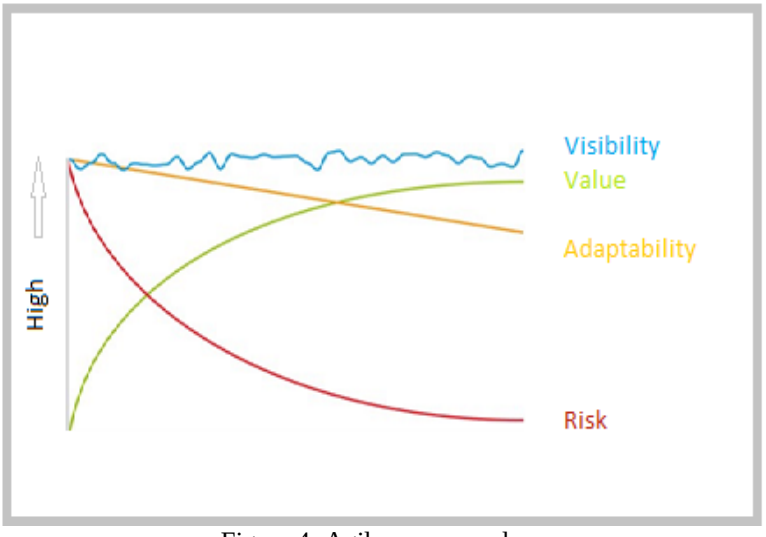

Figure 4: Agile process values

Hence the overall defect fixing and deployment cost also remains more predictable and low as the project progresses.

Inferences that could be derived from the above two figures that add to values out of Agile process are -

1. Almost consistent visibility of project health
2. Software usability which means a high value to users shows a steep rise even in the initial phase of the development.
3. The risk drastically reduced with the progress of the projects.
4. More stability with less upside cost movement in change management.
5. More predictable, low defect fixing and deployment cost with project progress.
6. Consistent visibility, high initial functional value and reduced risk with the progress.

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All these trends are typically found a contrast to the trends depicted by pre-existing methodologies which are employed for software development management.

C. Reasons for adopting Agile approach

Although the trends of adaptability show a good positive growth by comparing the past records of a decade as reported in abundance by many researchers, here we look at the adaptability reasons and the preference change recently by comparing the survey data of past three years that is, for 2016, 2015 and 2014 as reported by VersionOne. [7][8][9]. The data is very close as it belongs to the recent survey conducted for three consecutive years, and display slight variations only but it is good enough to point out the reasons for adaptability inclination as a whole in today's mature process adaptability movement. The minute but continues incremental variations of individual reasons of adoption in last three years further indicate the transition of practitioner's preferences. The data is presented in the table with this recent study as are shown in table 1 and graph is plotted to analyze the changes in trend as shown in figure 5.

Table 1: VersionOne report (Aggregated) for last three years on reasons for adopting Agile methodology.

Reasons for Adopting Agile	**9th annual report 2015**	**10th annual report 2016**	**11th annual report 2017**
Accelerate product delivery	59	62	69
Enhance ability to manage changing priorities	56	56	61
Increase productivity	53	55	53
Enhance software quality	46	47	43
Enhance delivery predictability	44	44	43
Improve business/IT alignment	40	44	42
Improve project visibility	40	40	37
Reduce project risk	38	40	31
Improve team morale	26	29	30
Improve engineering discipline	25	24	21
Reduce project cost	23	23	20
Increase software maintainability	22	22	18
Better manage distributed teams	20	21	18

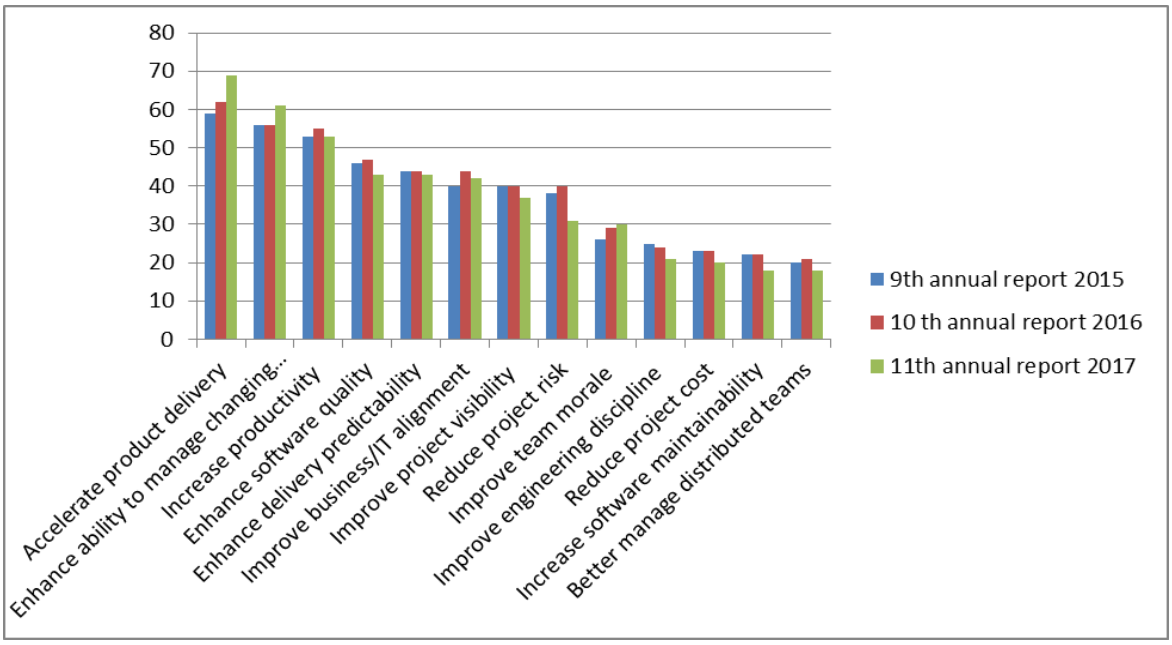

Figure 5: plot of Table 1.

The graph plot in figure 5, shows the most adoptable reasons on the left side of the graph and the reasons of least adaptability on right side. If we look at the first two plot-segments for three years in a stretch, we see that 'Accelerate product delivery' and 'Enhance ability to managing changing priorities' are showing positive growth in 2017 compared to 2016 compared to 2015. That would probably mean that these two factors are still on the gaining side of popularity, constantly leading and sought after adoptability reasons.

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IV. INVESTIGATION OF EVIDENCE OF AGILE APPROACH ADAPTABILITY BY INDUSTRIES OTHER THAN IT

A relevant and exhaustive literature review along with a survey of nineteen medium and large size companies from the non-IT background is presented in the work done by Edivandro C Conforto et. al. with the title 'Crucibles of leadership' suggest that although the non-IT companies are struggling with the difficulties of their current project management practices. But in reality, these project management approach is quite deviant from the Agile project management approach. The reasons analyzed in this work is summarized as, the 'success terms and conditions' and 'the working environment' of non-IT projects. It simply means that Agile approach is still far from getting its due recognition in terms of adaptability in the non-IT industry.[10]

Following is the reasoning based interpretation behind this log in the adaptability of Agile approach in the non-IT industry.

Roger's Technology Adoption lifecycle is one of the several innovation diffusion models and is well known for defining five district partitions of adaptors of innovation which is represented as a normal distribution.[11]

Moore in his discussion put forth the argument in the favor of the existence of a substantial gap between early adopters and the early majority and framed their gap as 'chasm'. Currently, the IT industry, in adopting the Agile methodology is on the edge to cross the chasm as shown in figure 6.[12]

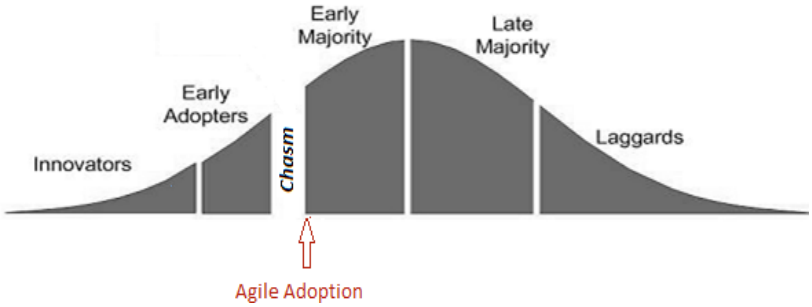

Figure 6: Technology adoption lifecycle and Agile process adoption

The success-factors are the reasons this transition that resulted in its high adaptability. While we see these success-adapters with low adaptability's evidence in the context of the Non-IT industry we argue that the chasm is much wider and adoptability is the middle of the chasm, as shown in figure 7.

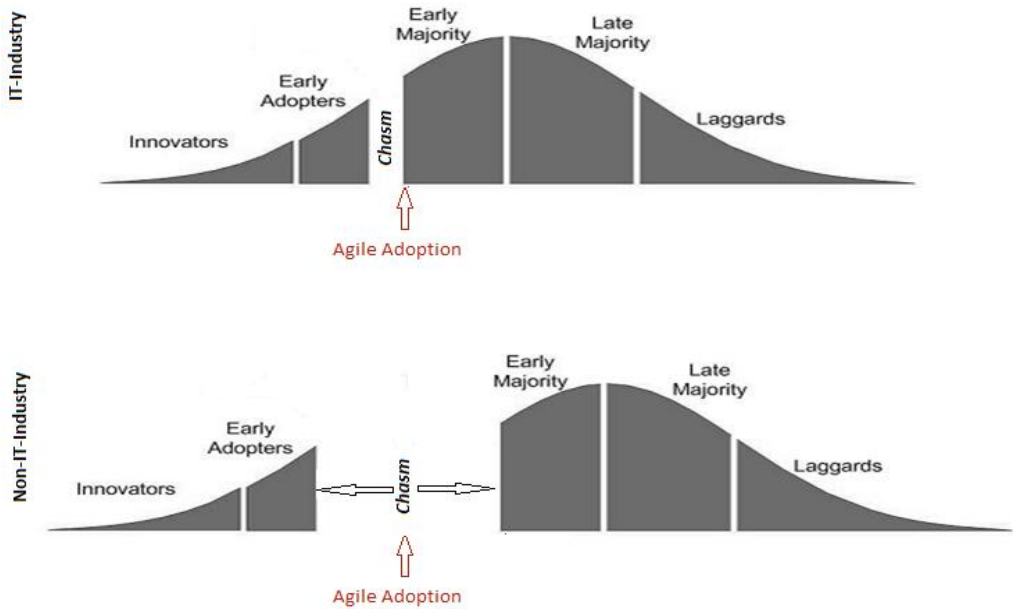

Figure 7: Technology adoption lifecycle and comparison of Agile process adoption in IT-Industry and Non-IT-Industry

Analysis of these three sets of success-factors as presented in the sections above, we figure out that second and third set as holds a deserved merits for any industry in general. However the first set of success-factors, that is, Principles behind Agile methodology are distinct and good with projects for which there are no pre-established standards or fast-changing standards and hence innovative in nature. Most of the IT project typically falls in this category. Contrary to this is a big subset of non-IT projects, specifically in core engineering disciplines that have well-defined standards, rigorously tested and stable procedures to follow. They also sometimes have a requirement to obtain a compliance certificate from the governing authorities and stakeholders. A relevant case study is reported in by Owen R et. al. which discuss the applicability of Agile project management to the construction industry [13]. The paper concludes that there is a good possibility of better results in terms of productivity and risk mitigation for pre-design and design phases respectively for a construction project with Agile project management approach. But the construction phase is of a different nature. The

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construction phase is influenced by lots of disperse factors. These factors include diversity of workforce, their professional abilities, and remunerations, education level etc. which leads to serious dis-alignment to Agile principles because of construction culture baselines, which are already well established to the roots of the process.

Moreover, values of Agile process as described in the agile manifesto along with its underlying principles encourage practices which may not be completely suitable in non-IT industry, specially core engineering projects.
A number of such Agile practices are listed which may not fit naturally to non-IT projects .

1. Close team collaboration may not be possible as the team includes varying skill forces of different capability and lot of hierarchical levels, leaving a big gap in process understanding and communication.
2. Roles could not be exchanged as easily as assumed by Agile methodology for non-IT projects.
3. Procurements and resource finding process may not best fit in Agile framework.
4. Whole team may not be capable to adapt to self-evolving ability. This requires high skill and motivations.
5. The team size in many non-IT projects need to be huge, which itself is contrary to Agile way of doing as it limits extensive and open communication and restricts the gelling of the team members.
6. Federated project distribution is difficult to follow up with Agile model
7. Compliance process and standard's certification dependency from external bodies is not iterative in nature.

So, the cause analysis points out the partial suitability of Agile methodology and hence needs the tailored approach that is custom made for respective disciplines and industry defects. For many disciplines, the Agile guidelines still needs to evolve or the guidelines are vague.

V. CONCLUSIONS

In this review work to answer the research question 'Can Agile deliver the same impact for non-IT projects?', on one hand, we have tried to establish the importance of Agile success-factors in IT-industry and their importance for any industry in general. On the other hand we compared the needs of non-IT industry with the instance of construction industry align the discussion in the context of a typical core engineering project. We found that although the Agile success-factors hold good value to such cases, however the principles of Agile methodology sometimes is an exception in the sense that it may not naturally fit some of the phases of development in non-IT projects. These principles derive the process tools and sub-practice which further define the industry specific tools and models and their way of doing things. Hence these Agile principles and their derivatives as the industry specific tools and models partially fit the nature of non-IT projects, so a hybrid modeling may be more suited to cater such needs instead of borrowing the whole of the Agile idea. To summarize the whole discussion in one sentence, we suggest the formulation of a tailored set of success-factors suited for each discipline individually, and then defining sub-process and tool on top of it to push the adoptability of Agile process across the chasm to fully harvest the agile process benefits.

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