

Final Year Project 2020

# *Software Process Improvement in Agile Practices Model (SDPM)*

**Subject:** Software Process and Quality Management

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## Introduction

Business needs for process improvement projects are changing. Organizations expect faster outcomes from their investments; they want their enhancement projects to adapt to and follow changing business needs, and to be more integrated with the way they work. The agile way of working, which is increasingly being used in software development, contains several mechanisms which support these business needs. So, the question is: **how software process improvement can be applied to agile methodologies?**

Given that software development is still a young and immature profession, software development and management need to be continuously improved. One way to arrange this is **software process improvement (SPI)**. The success of deployment in the context of process improvement may occur when the **commitment to the change** and **implementation effort** exist on both organization and project levels (Dybå et al. 2004).

Agile methodology for software development is a conceptual framework of practices and principles to develop software more rapidly, incrementally and to produce satisfied customers. Several agile methodologies for software development have been suggested in the literature, such as **Extreme Programming, Scrum, Rational Unified Process and Crystal Clear**. All these approaches take agile principles, for example, iterative development, frequent and early delivery of work software, and simplicity as defined in the **Agile Manifesto**.

Agile methods define how development should be conducted under agile values and principles, addressing challenges such as changing requirements, satisfying customers and rapid development. According to “**Agility is the ability of to both create and respond to change in order to profit in a turbulent business environment**”.

Many organizations use the **Capability Maturity Model – Integration [CMMI]**, which is a collection of best practices. A **process oriented** CMMI is the organization's maturity depends on the practices to be followed, and not on the outcome. But Agile practices promise satisfaction for customers, no overtime etc. It would hence not be a good idea to say that a given project is at the highest level of agile maturity while suffering from overtime and lacking customer satisfaction.

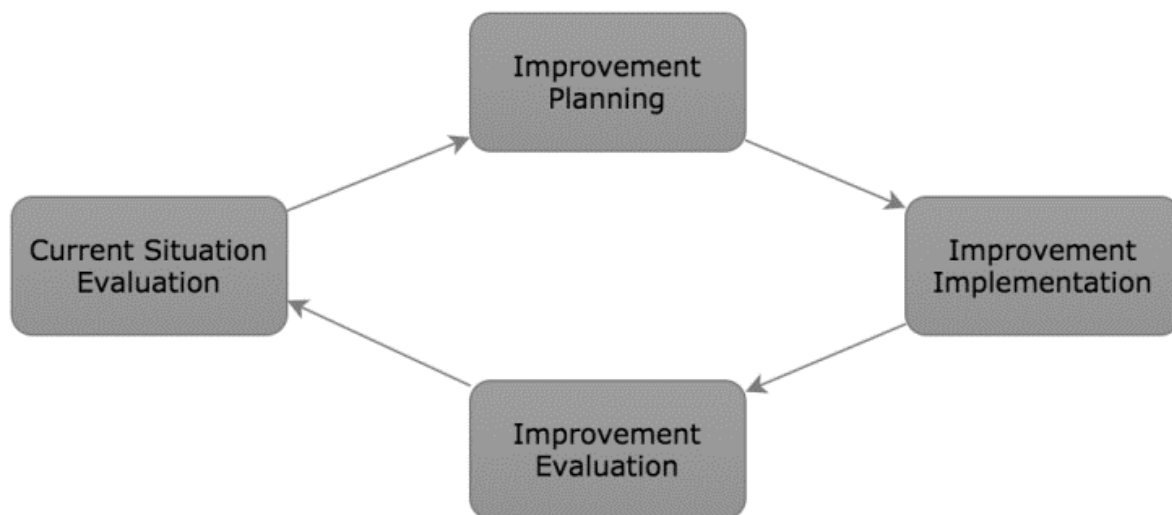
Therefore, our goal is to start filling this gap by systematically reviewing existing research on agile methodologies for software development. This work is organized as five sections. In the following section, we will discuss the meaning of software process improvement in details, then, what may affect the need for software process improvement, also, we will present some of the experiences with process improvement. Then, we will explain how CMMI is used in guiding the agile process improvement and how process improvement affected the output product quality.

## 1. Software process improvement: <sup>i</sup>

Software Process Improvement (SPI) methodology, it is defined as a sequence of **tasks, tools and techniques** for planning and implementing improvement activities aimed at achieving specific objectives such as increasing speed of development, achieving higher product quality, or reducing costs.

SPI can be considered as a **re-engineering process** or a **change management project** to detect inefficiencies in the software development lifecycle and to resolve them to have a better process. This process should be mapped and matched **to business priorities** and drivers should be updated to provide real value for the company.

SPI consists mainly of 4 cyclic steps as seen in the figure below, while those steps can be divided into more steps according to the method and techniques used.



### **Current Situation Evaluation:**

This step is the initial phase of the process and is primarily aimed at assessing the current software process situation by eliciting stakeholder requirements, analyzing current artifacts and deliverables, and identifying software process inefficiencies.

### **Improvement Planning:**

Following an overview of the current situation and the targets for change, the results should be grouped and prioritized according to which one is the most relevant or the most serious. We should observe what the new enhancement target level should look like.

### **Improvement Implementation:**

The planned activities are carried out in this phase, and it brings the changes into practice and spreads them around the organization.

### **Improvement Evaluation:**

What is cannot be measured cannot be improved, that is why the impact measurement compared with the goal, question, metric [GQM] is applied in this step.

## 2. The triggers that lead to software process improvement in agile projects: <sup>ii</sup>

Successful process improvement starts with a correct understanding of the word “process”. It means “work”.

**Process Improvement = Work Improvement**

**People like improving processes = People like improving work.**

**Quality depends on our processes = Quality depends on our work.**

The triggers that lead to software process improvement, may have a positive or negative impact on the agile projects and we will explain some of them

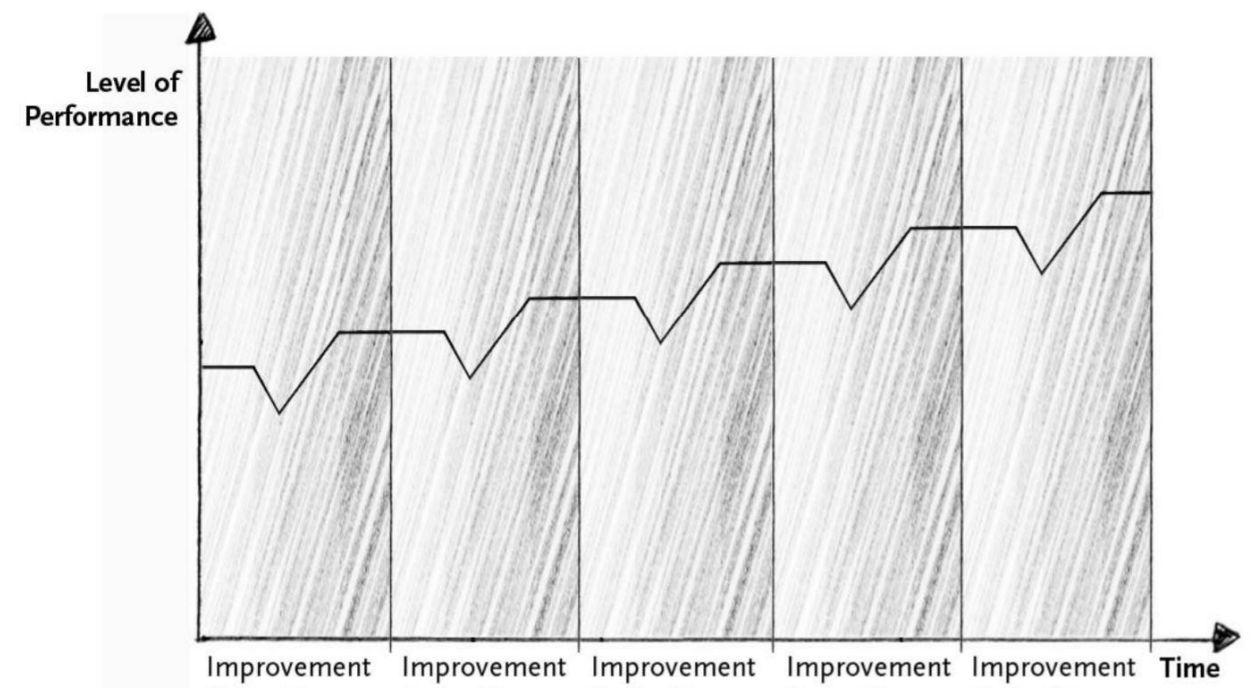
- **Positive sides of SPI:**

1. Competitive Edge, for example, being certified in CMMI, will place the business at a higher competitive advantage and boost its profits.
2. Improve customers satisfaction, project delivery on time with high quality.
3. Job satisfaction, employees get motivated to produce a high-quality project and to know what to do without the workload.
4. Meeting targets and reduce time to market, meeting organizational goals, delivery of projects, quality performance, useful products, technical documents are the SPI outputs.

- **Negative sides of SPI:**

1. Time pressure, Companies faces a lot of time pressure to deliver projects on the dedicated time.
2. Micro Organization, SPI is usually used in large organizations not in small ones.
3. Budget Constraints, SPI takes more time and resources, so that it leads to higher budget.
4. Bad Experience and lack of evidence for direct benefits, some organizations have employees with lack experiences and that may lead to bad implementation.

In the graph below, there is a directly proportional relationship between **the level of performance** and **improvement** over a period of time.<sup>iii</sup>



### 3. Some of the experiences with process improvement that can be applied to agile methodologies:<sup>iv</sup>

Software Process Improvement (SPI) is a unique initiative or project to improve the alignment and performance of a specific process with the organizational strategy and expectations of the customers. SPI includes the selection, analysis, design, and implementation of the (improved) process.

We have discussed the 4 steps of process improvement as mentioned before in section 1. These steps are applied into the process improvement methodologies as well and in our opinion, these three process improvement methodologies can be applied to improve agile methodologies:

- **Six Sigma** is a popular data-driven approach which is a process improvement methodology. It reduces defects to improve an organization's performance. Six Sigma involves two ways to break down process improvement through specific steps. These steps include define, measure, analyze, improve and control [DMAIC] and define, measure, analyze, design, and verify [DMADV].
- **Total Quality Management (TQM)** is an organization-wide effort focused on continuous improvement to improve customer quality, customer satisfaction is the result of the success of such methodology. It is a methodology that empowers workers by fostering a culture where employees are not afraid to make mistakes and are driven towards a shared business goal.

It predates Six Sigma methodology, as with Six Sigma, TQM can vary from company to company, but organizations using TQM generally follow these principles:

1. Organizations should follow a strategic and systematic approach to achieve their goals.
  2. Customers determine the level of quality.
  3. All employees work toward common goals. Effective communication and training ensure that everyone understands the definition of quality and strives to achieve it.
  4. Organizations should define the required steps of any process and monitor performance to detect any deviations. They should continually look for ways to be more effective and more competitive.
- **Kanban** is a systematic waste minimization process without sacrificing productivity and a process workflow visualization tool that brings business units, leadership, and employees to the same process improvement page. It is another methodology that incorporates and promotes **lean process improvement**. Although often referred to as Lean manufacturing, the core ideas of Lean can apply to any organization and process. Anyone using this method would be assessing the value stream of a process. In the process, the value stream consists of **value-added activities** (the actions a customer would pay for) or **non-value-added activities** that either bring a concept to fruition or complete an order. Any action that does not add value or that as part of a policy or regulation is not required is waste. Waste can include:
    1. **Transportation:** the movement of products unnecessary for the process.
    2. **Inventory:** materials that are not required to process current orders.
    3. **Motion:** people or equipment that move more than necessary to complete the process.
    4. **Waiting:** periods of inactivity or interruptions in production.
    5. **Overproduction:** excessive production of materials ahead of demand.
    6. **Over processing:** extra work due to redundancies or poor tool/product design.
    7. **Defects:** the effort involved in checking for and fixing defects in the system.
    8. **Skills:** the act of underutilizing the knowledge and skills employees have.

Below we present two case studies that demonstrate two different companies that use Scaled Agile Framework [SAFe] methodology to improve their processes: <sup>v</sup>

**1. LEGO:** (Year started: 2015)

- LEGO began its journey to agility by introducing changes at the team level. There were 20 product teams working at the organization at the time. At first, just 5 teams were transformed into self-organizing Scrum teams. Then, bit by bit, the remaining 15 teams followed in their footsteps.
- The result of that initial change was that although individual teams had become Agile, they still could not cooperate effectively together. To make that happen, LEGO followed the SAFe framework pattern and added another level of abstraction - the program level.
- At the program level, you have got a team of teams (also known as Agile Release Train, or ART for short). At LEGO, the team of teams was meeting every 8 weeks for a big room planning session, which lasted for one and a half days. During this meeting, teams showcased their work, worked out the dependencies, estimated risks, and planned for the next release period.
- There is also the portfolio level, which is the top layer of the system. This is where you have got long-term business plans, stakeholders, and top management. Such division into organizational levels is typical for the SAFe framework.

Results:

- Once you have empowered developers to manage their own work, **say goodbye to the army of “managers with spreadsheets.”** You can stop doing excessive documentation and other unproductive practices.
- **Developers now give more accurate estimates**, and the outcomes have become more predictable. Previously, the person who shouted the loudest could get their work done faster. Now, with visibility taken to the extreme, decisions are based on real necessity.
- **Nothing beats face-to-face communication** and the positive effect it has on team morale. Especially the communication that occurs during LEGO’s big room events.
- **Visual, almost gamified planning helps focus**, makes things obvious and easier to resolve. Giving people independence also makes them more motivated, and they do better work.



## **2. Cisco** (Year started: 2015)

- This case study has been written by Cisco's Ashish Pandey. Please note that it concerns a specific Cisco product - the Subscription Billing Platform.
- The project used to follow the Waterfall methodology. Cisco used to have separate focus teams responsible for design, build, test, and deploy. Defects were many, and deadlines were being frequently missed. People were working overtime.
- Once they switched to SAFe in 2015, here is what happened.

Cisco created three [\[ARTs\]](#) (Agile Release Trains) for:

- Capabilities
- Defects/fixes
- Projects

Every day, the team had a 15-minute meeting to determine work items. With SAFe, they attained greater transparency: each team knew what the other teams were doing, and teams were able to manage themselves, promoting accountability through status updates/awareness. They also combined it with the Scrum framework that was being used on another product - the WebEx app for Samsung. Some XP practices, such as test-driven development and continuous integration (CI), were used, too. The conclusion is that you can use one framework for one product and another Agile framework for another one within the same organization.

### **Results:**

Once Cisco started following the SAFe methodology, started to release often, and introduced Continuous Integration (CI), they got:

- **A 40% decrease in critical and major defects.**
- **A 16% decrease in Defect Rejected Ratio [\[DRR\]](#).**
- **A 14% improvement in Defect Removal Efficiency [\[DRE\]](#)** - thanks to CI and more interaction between international teams.
- **There is no more overtime**, and the product increment is delivered on time.

#### 4. Agile process improvement using CMMI:<sup>vi</sup>

CMMI helps companies take advantage of agile and scale its adoption through departments, divisions, and the global market. Improving Agile Performance with CMMI to help users embrace and apply CMMI in agile organizations to boost performance.

Improving Agile Efficiency with CMMI as a roadmap for efficient, agile and CMMI adoption and deployment together. The CMMI offers a structure or diagram of "what" an organization will do. Agile offers different approaches which prescribe "how" to do so. The CMMI provides the foundation on which organizations can iterate or tailor their techniques in a way that is appropriate to the dynamics of their business environment as methods and techniques are adapted and evolved. The methodology, organizational learning and consistency generated by the adoption of CMMI help organizations make their implementation even more agile and efficient

“CMMI Institute estimated that over 70% of CMMI appraised organizations reported using agile. Agile organizations struggling with issues of performance are increasingly turning to the CMMI for proven results. For example, Minacs IT Services experienced a 30% to 40% increase of attaining sprint commitments, a 30% increase in the number of user stories delivered in each sprint, and 40% increase in on-time delivery after applying CMMI to existing agile processes.”

- The table below maps some common business problems where the CMMI will provide guidance for improvement:

Problems	Agile Ceremonies /Techniques		CMMI Process Areas
<b>PROJECT ESTIMATES ARE UNREALISTIC OR UNKNOWN.</b>	<ul style="list-style-type: none"><li>• Team Estimating Game</li><li>• Planning Poker</li><li>• Sprint Planning</li><li>• Backlog Grooming</li></ul>	<ul style="list-style-type: none"><li>• Requirements Development</li><li>• Task Estimation</li><li>• Release Planning</li><li>• Sprint Backlog</li></ul>	<ul style="list-style-type: none"><li>• Project Planning</li><li>• Integrated Project Management</li><li>• Requirements Management &amp; Development</li><li>• Measurement and Analysis</li></ul>
<b>TIP:</b> Prior to starting work, a Team Estimating Game or Planning Poker should be used to estimate the high-priority user stories from the Product Backlog to determine what can be part of the upcoming sprint; this will help to understand the complexity and cost of requirements.  During Release and Sprint Planning, team velocity, if the team is largely unchanged, should be considered. This will enable the team to select an appropriate number of user story points to include in each Sprint.			
<b>PROJECTS DO NOT GET DELIVERED ON SCHEDULE.</b>	<ul style="list-style-type: none"><li>• Daily Standup/ Daily Scrum</li><li>• Release Burn-Down</li><li>• Sprint Burn-Down</li></ul>	<ul style="list-style-type: none"><li>• Task Estimation</li><li>• Release on Demand</li><li>• Incremental Release</li></ul>	<ul style="list-style-type: none"><li>• Project Monitoring and Control</li><li>• Measurement and Analysis</li></ul>
<b>TIP:</b> During a project, there should be regular backlog grooming to continue breaking down user stories for upcoming sprints. Some organizations have had positive results with more frequent “micro-grooming” sessions that focus on smaller user stories and tasks.  As part of project monitoring, the Daily Stand Up meeting should review Burn-Down Charts to understand whether the Release/Sprint is on schedule.			

## 5. Improvement of the process affected the quality of the output product: <sup>vii</sup>

There are pros and cons of process improvement on the output product:

- **Some of the advantages are:**

1. Improved product quality: Process improvements can lead to higher product quality, in addition to accelerating development. For example, by deploying the proper testing methods, companies can be more assured that only when performance, security, integration, and other issues have been solved will products advance to production.
2. Increased productivity and efficiency: Continuous process improvements can help reduce inefficiencies, which eventually increase team members' efficiency.
3. Faster time to market: Improving processes by using tools like Kanban boards and Gantt charts will help businesses deliver faster software applications and other products into production.
4. Increased customer satisfaction and loyalty: Producing higher-quality products and delivering them in a timely manner can lead to more satisfied customers. **Happy customers are often return customers**, and this satisfaction contributes to improved company sales.
5. Improved employee morale: Inefficient processes for the workers can be highly discouraging. Who wants to be part of a fractured system that leads to frustration? "Weak business processes can cause the morale of even the most hard-working employees to decline if they start to feel that all their efforts are being overwhelmed by the flaws of a system" notes online job site Cleverism.
6. Competitive advantage: Continuous improvements to the process can help distinguish companies from their competition.

- **Some of the disadvantages are:**

1. Customers can complain about the quality of the products or bad service.
2. Members of the team get frustrated.
3. Work can be duplicated or not completed at all.
4. Costs can go up.
5. Resources might be wasted.
6. Bottlenecks may develop which may cause teams to miss deadlines.

References:

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<sup>iii</sup> [https://resources.sei.cmu.edu/asset\\_files/Presentation/2009\\_017\\_001\\_22328.pdf](https://resources.sei.cmu.edu/asset_files/Presentation/2009_017_001_22328.pdf)

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<sup>v</sup> <https://www.objectstyle.com/agile/scaled-agile-success-story-lessons>

<sup>vi</sup> <https://cmmiinstitute.com/cmmi-and-agile>

<sup>vii</sup> <https://www.planview.com/resources/articles/why-process-improvement-important/>