Agile Management in Technology and Organization

Quality Management in Agile Projects

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1 Introduction to Quality in Agile Project Management

With the increase in the complexity of the products, agile methodologies have proven to be vital for the management of complex environments. Agile methodology is an iterative approach for software development and project management which is rapidly expanding across other application and industries that helps teams deliver to their customers faster and more efficiently. The teams deliver small developmental increments of the products which enables them to respond quickly to the changes. Small team members with individual expertise come together to execute a certain task in small chunks over a fixed period to be ready with a potentially shippable product. Agile methodology for project management has been proven over and again to deliver superior quality products in a shorter period with a degree of flexibility that can cater to the changes in the requirements of the customers. Agile project management also ensures better predictability and increased control of the projects. All these aspects make agile project management to be a well-suited technique to manage projects in today's day and age.

During the development processes in agile methodology, the teams have the responsibility to build quality alongside developing the product. This is ensured by putting into place the best engineering practices to build the products with highest quality. This is unlike the traditional method of project management where the quality is addressed reactively rather than proactively by the product testing and resolution of the issues. The major challenge in implementing waterfall model of project management in complex situations is that the development and quality testing of the product is not cohesive which can lead to uncertain errors during performing the quality management steps. This not only increases the project timeframe but also the corresponding costs incurred by the project. In case of agile quality management, each and every individual is responsible to make sure that the outcome possesses highest quality. Communication and transparency between team members ensure the fulfilment of quality requirements. The agile methodology also has a constant emphasis on improving the delivered products which requires flexibility in terms of the project execution as well as the quality management techniques.

The quality management in agile projects plays a vital role as it is important to incorporate highest quality along with the processes so that with frequent changes, the quality of the output is maintained and does not get compromised. It is due to this nature; the agile quality management takes a different approach when compared to the conventional quality management methodologies. The fundamental aim here is to discuss how the methodologies used in quality management following the conventional waterfall method is different from the agile method of project management, how to ensure that the quality is incorporated into the agile project management techniques and look at the state of art methods for agile quality management.

2 Risk Management

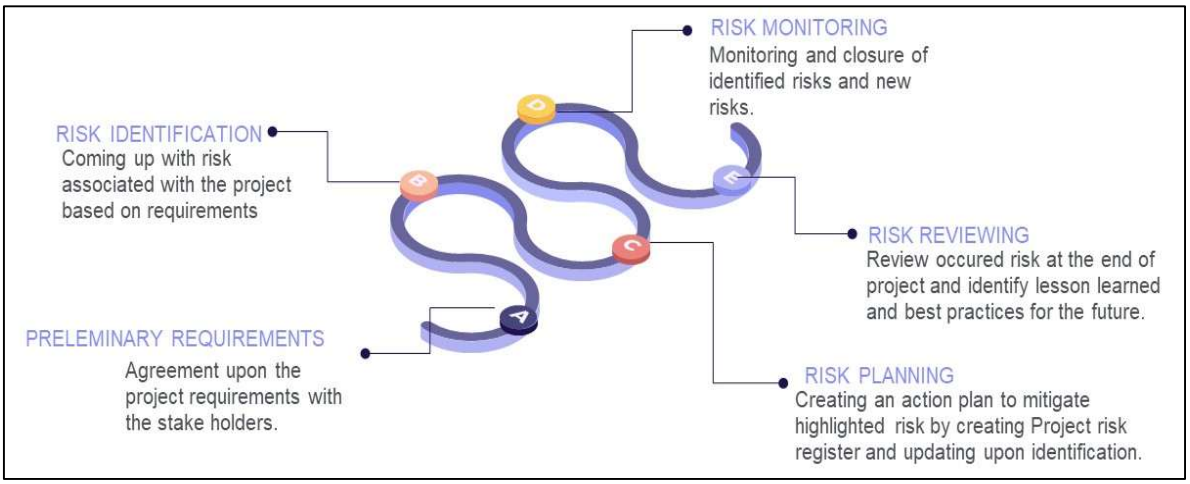
2.1 What is Risk

Risk is an unexpected event that affects the performance of the project. Risks may always not be detrimental, but it leads to instability. Risks are also not same as issues as issues are generally predictable in nature and can be dealt with. Risks are the non-predictable factors that might happen, and the timeframe of risks are not known.

2.2 Why is Risk Management important?

It is important to understand that successful quality management is essential for expert risk management of projects. The risk management focuses on the project objectives and on the defined target of the project during the project planning phase. This can be achieved by setting adequate quality management methods in place to ensure that the defects or undesirable results during a project execution is prevented by continuous improvement, development, and testing of the processes. Project managers often fail to set the appropriate project timeline and budget which meets the highest cost, quality, and delivery standards because the projects are at high risk and fail on at least one of these following attributes. By incorporating risk management along with the quality management, risks can be predicted beforehand which will make certain that the quality standards are achieved. The general tasks of risk management begins with establishing the content in discussion with the stakeholders followed by risk identification, planning risk, monitoring risks throughout the project and reviewing risks.

Figure 2.1: Risk management roadmap



Risk management when given high priority also creates an environment that promotes innovation which enhances the project performance. The risk management iteratively should follow assessment, control, communication and reviewing of the risk throughout all the stages of the project. Recognizing sources of uncertainty builds confidence and helps identify the project limitations.

This can be achieved by collecting background information, risks from previous projects, analysis, opinions, and stakeholder concerns. Ensuring that what could potentially cause failure to the project and how it can be tackled, the project team can discover the golden opportunities which will verify project progress in the correct direction. To assess risks, three basic questions may be raised which would elaborate the consequences of the risks:

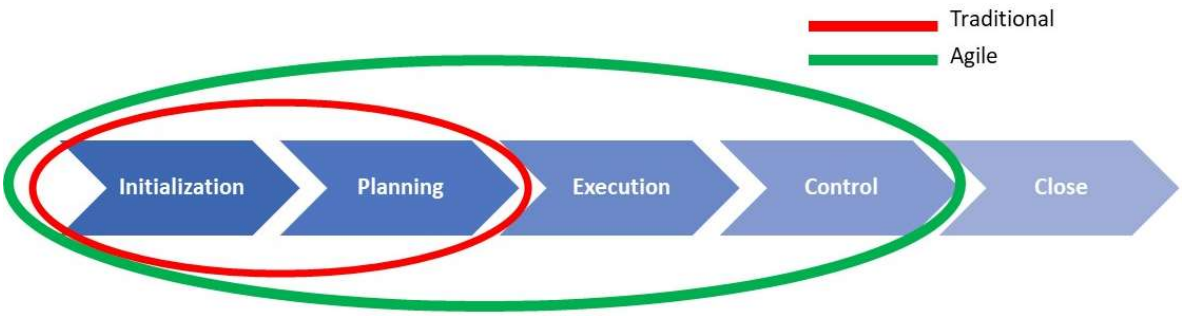
1) What could possibly go wrong?
2) What is the certainty that the progress could go wrong?
3) What are its repercussions?

Based on these three key questions, the risk management procedure can be dealt with in detail and various tools and techniques have been developed to address and tackle risks at various levels of project.

2.3 Risk Management in Agile Projects

Agile methodology is being increasingly used for project management in recent years. This is done to shorten the delivery times and reduce the cost incurred. The key difference between risk management in traditional project management and agile project management is that in the traditional project management, the risk is identified upfront during the project life cycle initiation and then is revisited and updated after the project planning phase whereas in agile, the risk is identified throughout the project lifecycle.

Figure 2.2: Traditional Method Risk Management During Project Management Lifecycle



Various tools and techniques can be used for a descriptive analysis of risks. One of the state of art technique for the realization of this task is discussed below.

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2.3.1 FMEA (Failure Mode and Effect Analysis)

To identify risks and update them throughout the project lifecycle, FMEA (Failure Mode and Effect Analysis) is the state-of-the-art tool. It defines in detail about the risks associated with the projects which has been identified throughout the project life cycle and is updated in every

sprint. This ensures that the identified risk during the project is identified and added in the list and an appropriate preventive measure in set in place.

Figure 2.3: Failure Mode and Effect Analysis

Failure Mode and Effect Analysis

Project name: E-Learning	**Target Start Date:**	01.07.2020	
Project Number: 12345	**Target End Date:**	31.10.2020	
Program Name: 0	**Company Number:**	0	
Sponsor: Mr. X	**Cost Center:**	12121	
Business Owner: Ms. Y	**Created Date:**	03.09.2020	
Project Manager: Mr. Z	**Revision:**	123	

Risk Assessment

Risk ID Number	Risk Categories	Risk Description	Severity of Impact (1-5)	Likelyhood of occuring (in %)	Risk Rating	Contingency Plan Required (Yes/No)	Risk Approach	Risk Response Summary	Risk Owner
A1	Project Execution	Insufficient resources to complete the project successfully	5	0.8	4	Yes	Risk Avoidance	On technology side, resources involved with development platform	Martin or Gunther

Table 2.1 FMEA Attributes

S.No	Attribute	Reflection
1	Risk Categories	This reflects the category of the potential risk. Generally the categories can be as follows: 1) Business Continuity 2) Compliance 3) Commercial 4) Finance 5) Fraud/Theft
2	Risk Description	The detailed description of the risk identified
3	Severity of Impact	Indicator to show how detrimental is the effect of the risk
4	Likelyhood of Occuring	How likely the risk can occur (In percentage)
5	Risk Rating	Index for the comparison of various risks with respect to its severity and occurrence
6	Contingency Plan Required	Availability of a contingency plan for the risk
7	Risk Approach	Approach to the response to the risk. Can be categorized as: 1) Risk Avoidance 2) Mitigation (Controlling) 3) Acceptance 4) Share or Transfer (Allocation)
8	Risk Response Summary	How the risk needs to be tackled

The FMEA document is a strong used case for agile methodology due to the following reasons:

- It can cope with high levels of change. Due to high complex environment and constant changes, the FMEA can be parallelly updated to keep track of each and every small changes.
- When planning FMEA initially, the planning team can be never 100% sure of the exact requirements and hence the risks. These risks can evolve throughout the project thus making it highly suitable for agile risk management.

- FMEA may consists of risk identified by multi-cultural teams for different perceptions which can be inter-related. This makes the communication of risk transparent.
- The qualitative and quantitative deficiencies can be updated by input through the feedback by the team members.
- Sub-FMEA can be created in order to review and track risk associated with each and every small deliverables.
- Unexpected variations in FMEA documents are easy to spot and modified which helps with low wastage of time and funds.

3 Project Quality Management

Project quality management is the process which reflects how the project should progress to achieve desired project deliverable's quality. It is vital to ensure that the deliverables satisfy the end customers/stakeholders in terms of fulfilling their expectations and needs. The benefits of project quality management are as follows:

- Better quality products
- Reduces project failure and rework
- Increase in productivity
- Guaranteed financial growth
- Customer Satisfaction and trust building
- Continuous process and product improvement (Plan-Do-Check-Act Loop)
- Reduce Management Responsibility
- Minimize cost-of-quality

The project quality management aids continuous measurement of the quality for all the activities and deciding the appropriate corrective action until the required quality standards are achieved. While it may seem like project quality may seem like an attribute that is measured once the project is completed, this is a misconception. After all, it is of no use to measure the project quality after its completion or delivery as there stands no scope of improvement. It is therefore important to implement quality management throughout all the phases of the project. There are three processes of project quality management that needs to be implemented to ensure that the project is in accordance with the requirements designated by the stakeholders/customers.

1) Quality Planning
2) Quality Assurance
3) Quality Control

These processes will be elaborated based on a used case example of a project for automotive software development.

Figure 3.1 Project Quality Management Cycle

3.1 Quality Planning

The quality planning is the first phase of a project. It acts as a project's quality guide that the team and the stakeholders must comply with. The quality planning is done based on the prerequisites decided by the customers/stakeholders and the team's mutually in such a way that all the requirements are fulfilled. In case of agile project management, these prerequisites should be updated with each sprint and the inputs from the sprint reviews as the project progresses to enhance the overall project quality.

In the automotive software development example mentioned above, quality planning for is based on a five-stage model which ensures that no activity throughout the lifecycle that can deteriorate the product quality is missed. This modelling for planning is based on Gerresheimer group's quality management process. The quality planning also acts as a catalyst for deciding on quality assurance factors throughout the project. The plan can be represented in form of a matrix extending to the five stages of the project from initialization to completion. The activities defined in the quality plan of the corresponding phases must be completely met in order to proceed to the next phase. Certain event also can span to multiple phases and these needs to be catered to in their respective phases.

Table 3.1 Quality planning based on Gerresheimer group quality management process

Module	Phase I	Phase II	Phase III	Phase IV	Phase V
1	M1: Q Phase Review: Input variable from the previous phase present	M1: Q Phase Review: Input variable from the previous phase present	M1: Q Phase Review: Input variable from the previous phase present	M1: Q Phase Review: Input variable from the previous phase present	M1: Q Phase Review: Input variable from the previous phase present
N/A	Conceptualization				
N/A	Regulatory Requirements				
2	Purpose of automotive software				
2	M2: Risk Management plan	M2: Risk Management plan			Support for development and deployment
3		M3: Risk Management	M3: Risk Management	M3: Risk Management	
4 and 5	Specifications	M4:Software verification planning	M5:Software verification planning		
4 and 5		M4:Software validation planning	M5:Software validation planning		
6 and 8	Development concept (Hardware and software)	Details of Development process	M6: Development testing factors plan	M6+M8: Development testing factors plan and create and handover testing results	
6 and 8		Hardware selection			
7	Supplier search/Hardware Manufacturing processes	Supplier selection for hardware/in house manufacturing	M7: Quality of outsourced/in house manufactured hardware		
1	M1: Q Phase Review: Input variable from the previous phase present	M1: Q Phase Review: Input variable from the previous phase present	M1: Q Phase Review: Input variable from the previous phase present	M1: Q Phase Review: Input variable from the previous phase present	Conclusion of the project

There is also a compliance that needs to be achived which defines individual activities and the corresponding responsibilities. This compliance is obtained based on the RCAI Matrix. Also, the activity designates a time frame through gantt chart so that the project meets the decided timeline.

The benefit of quality planning is to judge before the project beginning the activities which needs to be performed along with their respective timeline in order to ensure quality . Often times, the product owner along with his team takes excessive time in the quality planning process. This may be detremental as excess time investment in planning phase will reduce the overall available time for the actual implementation and also will create ambiguity. Thus, it is very important to adhere to the timeline designated for quality planning process.

3.2 Quality Assurance

Quality assurance is the process that records evidence to the customers that all the quality related activities are performed as decided. It ensures that all the appropriate guardrails are set in place to make sure that the expectations are met with high quality standards.

Quality assurance test uses a system of qualitative and quantitative metrices to evaluate project quality hence enhancing customer satisfactions. These audits results are then reviewed and the scope of improvement is evaluated based on the reports. In case of agile project management, these metrices are evaluated after every sprint. Quality Assurance is different when compared to quality control as it is preventive in nature as supposed to the reactive nature of quality control processes.

In the automotive software development example mentioned above, the quality assurance can be ensured by performing the SQA (Software Quality Assurance) activities:

Table 3.2: Quality assurance activity chart for software development

S.No	SQA Activity	Purpose
1	Creating SQA Activity plan:	This step involves creating an activity chart that defines the procedure to carry out SQA in the project
2	Checkpoints Designation	This step involves the setting up project milestones and carry out project SQA activities.
3	Formal Technical Reviews	This activity is done to test and evaluate the prototype and discuss the progress.
4	Multiple Testing Strategy	This activity ensures that the software is tested in multiple ways to ensure that it can be ensured from multiple dimensions that the software is functioning according to the required quality.
5	Process Adherence	This activity confirms that the software is developed by using the procedures defined by the organization
6	Product evaluation	This activity verifies that correct steps are taken for software development and is in compliance with the documented steps
7	Change Impact measurement	In this activity, the impact of change is determined.
8	SQA Audits	This activity checks that that the entire software development process is being followed as defined.
9	Maintaining Reports and Data	This activity involves documenting the results, reports and change requests for reference
10	Ensure healthy relationship between team members	This activity is crucial for smooth functioning of the team and maximum efficiency of each team member

We can clearly see that the above defined quality assurance activities are all preventive in nature. These activities can be further supported according to the application by the Failure mode and effect analysis (Product or Design) to strengthen the quality assurance processes in a project.

As discussed, quality assurance ensures customer satisfaction and builds customer confidence as it shows that all the quality related activities put into place is being followed. It also verifies that the customer receiver quality products promised by the supplier. However, quality assurance is time consuming and demands additional resources. This increases the overall cost of the product. Also, since cost-to-quality is an intangible cost, addition of quality assurance activities may be prone to increase in the cost but not necessarily the product quality. The project manager and the team members therefore carries a huge responsibility of deciding the appropriate amount of quality assurance activities thus keeping in check the cost-of-quality and time.

3.3 Quality Control

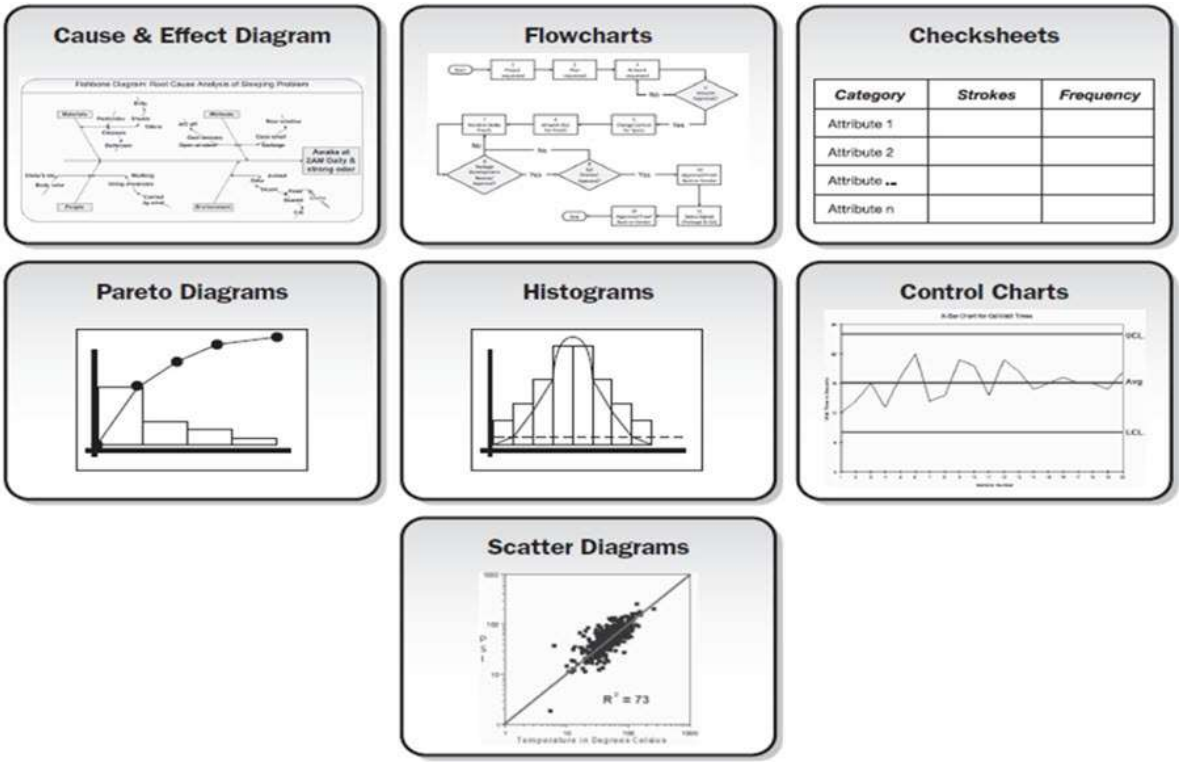
Quality control are the techniques that ensure quality standards. Unlike quality assurance, quality control is a reactive process which identifies, analyzes and corrects the problem once it occurs. Quality control requires constant monitoring through the means of testing and inspections. Quality control in case of software is a systematic set of process used to ensure the software meets the quality standards. This includes both functional and non-functional requirements. The quality control for software is carried out through testing and monitoring during the development and implementation process. The process control is carried out through the quality control tools which ensures that the processes satisfy the required standards defined by the organization.

3.3.1 Quality Control Tools

There are 7 Basic quality control tools:

- Check Sheet
- Fishbone Diagram/Ishikawa diagram
- Histogram
- Pareto Chart
- Control Chart
- Scatter Diagram/Stratification
- Flow Chart

Figure 3.2 7 Quality Control (QC) Tools



The 7 Quality tools are widely used in many applications. These are versatile for decision making, problem solving and judgements and are based on the indices created because of any processes. These tools clearly represent any abnormality in the process or product attributes which helps addressing the problem immediately at a given point in time. Apart from these 7 basic tools, there are more tools and techniques like relationship diagram, hierarchy diagrams and matrix data analysis that can be used according to the application to make sure that the process and the resulting products are as per the designated standards.

The quality control is a continuous process which is aided by frequent inspections and testing and therefore is incorporated into the process. Quality control is generally performed in the final stages of the process. Even though it confirms that the customer gets the products with high quality, quality control does not generally prevent the wastage of resources when the products are faulty. Due to the detection of the defect in the final stages of process, wastage is often high and additional time crunch is created. The quality control also costs money i.e testing cost, wages, apparatus cost etc. Quality control also does not encourage all the team members to contribute for quality of the product. Therefore, it is desired that in the process of quality management, the quality assurance is designed to be stronger thus reducing the cost and time invested in the process of quality control.

4 Conclusion

In order to accomplish an effective project outcome, incorporation of quality management in project management is very important. The iterative nature of project management cycles in form of agile methodology and various frameworks associated with it demands a modification in the conventional method of quality management. This is established using the iterative form of quality management. Unlike conventional project management, agile project management demands that the quality management is incorporated throughout the project management lifecycle. It is vital that quality stands as a responsibility of each and every team member. An effective project management starts with an effective quality planning. This is done through identifying the preliminary quality factors and planning them throughout the product life cycle. Simultaneously, improving the quality planning as the project progresses is vital based on past data, learnings, change in requirements and progress. Secondly, a strong quality assurance needs to be set in place to ensure that all the factors that can deteriorate the quality of the project are kept in check. This can be ensured through creating quality assurance activities which has to be checked in all the processes to make sure that the process parameters are being maintained as described in the requirements. Again, the quality assurance activities can change and improve based on the project progress and change in requirement. Quality control acts as gates to ensure that the output quality is being met and the project is under control. These are obtained through analyzing the output parameters of the processes as well as products. Quality control can be ensured with the use of various quality control tools. The pre-defined standards are therefore vital as its definition acts as the quality control parameters which the process should suffice.

Risk management is equally important in ensuring the project quality as it can inform in advance about the potential threats to the project's progress. An effective risk management can be done by obtaining the FMEA (Failure mode effect analysis) of a process. These identified potential failures and its corresponding actions be integrated in order to obtain an effective quality assurance activity chart. In the example of the automotive software development, it can be clearly seen that incorporating the three core quality management processes effectively can help verify quality in the planning, development and implementation phases and ultimately provide the required overall quality of the project and its output.

Finally, maintaining quality management data and documents in an efficient way is important as it builds customer confidence, helps in tracking the current project and also acts as a database for implementation of quality management in future projects. Hence, an efficient quality management system should be an integral part of an efficient project management.

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