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Developing a Risk Management Framework in Construction Project Based on Agile Management Approach

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Abstract

Construction projects in nature, carry a lot of risks, and unpredictable conditions. Thus, flexible management is required for the purpose of efficient responding to the various changes appear during their implementation. As an attempt to deal with risk in the construction project, this research aims at proposing a risk management framework in construction projects that built based on Agile management concept, which is a sequence of procedure deals with the project' primary vision to its final delivery. The risk management framework will trace alignment and discover a contact between Agile and traditional project management concepts and find contact points among two of the more used Agile frameworks (Scrum) and one of the more confirmed project management framework (PMBOK®) processes. This will result in a recognition of comparable areas between Scrum and PMBOK® processes. The goal of the framework is to assist the project managers to adapt a more flexible approach to managing and implementing the construction project. The results proved that Agile management process from the create prioritized project backlog, sprint planning, sprint review, to sprint retrospective procedures and less time of the cycle, eliminate or mitigate many risks that lead to project challenges and failure.

Keywords: Agile; Scrum; PMBOK; Construction Project; Risk.

1. Introduction

Construction project's managers must effectively manage the projects throughout its entire life-cycle. The managing process is not an easy function as all construction projects consists of multi disciplines and involves high-risks. The efficiency of the construction process is frequently associated with the successful risk management [1]. Risks of all projects are conditioned by an environment, and they must be considered for aiming better results in terms of scope, schedule, cost, and quality of the construction project [2]. The applicability of a construction project is a challenge when there is a high degree of complexity and uncertainty. In many construction projects, there are unique products, inevitable changing of requirements, and a necessity for actions that are highly focused on meeting client/customer needs.

To improve the challenging coordination, planning and control-work of construction projects, there is a necessity to have efficient methods which take into consideration that the projects are often initiated under large uncertainties. Such situations require management methodologies that are characterized by being flexible and ready to respond to the change. Recently, Agile project management is gaining very wide global attention, and it is considered as the today's projects management strategy, contrasted to what is usually known as a traditional project management.

In comparison with the traditional methods, Agile management keeps in mind that it is unattainable to predict the

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future. Agile' supporters believe that it is possible to be more appropriate for projects management due to the fact that it has the ability to incorporate ways to deal with all changes [3]. The traditional management consider that the future is predictable as plans are made without taking into account occur undesirable changes. They meant that the considerations of predictability are problematic as money, resources, time are utilized according to old plans, thus leads to waste. Due to these dissatisfactions, project managers came up with a more flexible approach to managing projects, called "Agile management". In comparison with the traditional methods, the Agile methods take into account that the future is impossible to predict.

Although there is a wide range of Agile methodologies, they all share the similar basic objectives. These objectives can cover substituting upfront planning with incremental planning based on the most current available information, addressing the technical risks in the process as early as possible to minimize the changing requirements impacts, delivering regular and continuous business value to the organization, entrusting and empowering staff, encouraging ongoing communication between business areas and project team members, as well as increasing the client's involvement [4]. For this research, Scrum was chosen to follow the guideline of the most applied and most popular Agile methods.

Hence, this study aims to develop a framework for the risk management in construction projects based on Agile management principles to reduce the impact of risk and to find a bridge between Agile project management and traditional project management approaches.

2. Literature Review

In Agile projects, Risk management has been discussed by many researchers. Diverse techniques and many models have been developed to effectively formulate the potential risks imposed by projects and different Agile methodologies have been proposed to tackle the risk problems assigned to any projects. Researchers have also performed a surveys with various objectives to recognize how project managers manage risks in Agile projects.

In (CAN/CSA S806-11) [5] focused on the use of risk management in Agile model. The results showed that using Agile management can reduce risk in early phases of the project, which is otherwise considered during project management in the traditional model. Moreover, it has been concluded that Agile is based on the organization requirements' realities rather than imaginative over-analysis. A comprehensive risks categorization that faced practitioners in managing distributed Agile projects has been created by El-Sayed et al. [6] in addition to identifying the risk management methods, which are often used in practice to control those risks. Leavitt's model was used to map the risk categories of the organizational change in order to simplify the implementation of results in the real world. Indeed, the results revealed the risk factors that could be due to the inconsistent properties of the distributed project development.

ACI Committee 440 reported in their study the current practices in Agile project management throughout a survey [7]. They proposed an Agile framework for managing projects, depended on two well-known approaches; Scrum and PRINCE 2, by risk management aspects. An analysis to Agile methodology (Scrum) has been carried out in addition to highlighting the management extent of the risk [8]. This will help in overcoming Scrum' limitations throughout the analysing phase of the risk. This will help in providing the association among the dominant risks as well as handling the risks order as multiple risks can be instantaneously eliminated or decreased. An Agile Development Maintainability Measurement (ADMM) model has been proposed by Soundararajan et al. [9]. Agile Development Maintainability Enhancement (ADME) defined the procedure for reducing the risk of requirements change, based on (ADMM) model. The advantages of ADMM model and ADME procedure were concretely identified Agile development maintenance quality defects and provided correction suggestions and effectively improve Agile development maintenance quality that can concretely handle change requirements and reducing the development risk.

Djelailia et al. studied similarities and differences between the project risk management process in Agile projects and waterfall projects, as well as identified the strengths and weaknesses in the current practices used in Agile projects. Interview results suggested that risk management in Agile projects was implemented in two ways [10]. One way is by adopting implicit risk management strategies, which include communication and collaboration, shorter iterations, frequent delivery, early feedback, and delivering complex parts first. The other way was called explicit risk management strategies, which are relative estimates, burn down charts, SWOT analysis, and risk matrix. In Mustafa et al. established a framework for risk management that covers the supposed risks in distributed Agile development projects, their reasons and the managing approaches for those risks used in the industry [11]. The limited authentication of the framework in three various companies has described eliminating most of risk aspects and/or reducing their impacts.

Smring et al., proposed an Agile-based risk rank scheme to prioritize the risk factors in Agile projects [12]. To reduce the influence of risks, the proposed scheme offers ranking of superiority for risk factors from high to low. Results validated the claims that the proposed Agile based risk method is significant to identify and prioritize the risk factors in early phases project. Hind et al., presented a theoretically informed and empirically grounded model to mitigate and assess risks for effective sharing of Agile development knowledge [13]. Indeed, a quantitative approach for Agile project

planning has been emphasized by Subramani and Jayalakshmi (2015) [14]. Also, a risk management model has been introduced, which can produce risk metrics to support risk avoidance and risk mitigation. Both project simulation model and risk metrics were utilised to correct the project factors, for instance cost, time and scope during the lifespan of the project. In [15], the author analyzed and collected the factors of the critical quality of user stories resulting to propose a quality measurement story model for the user. The results of applying the user story quality measurement model enhanced the requirements quality of Agile development and reduced risks of requirement changes.

The underlying risk management model in an Agile risk tool has been described in Pathak et al. [16] in which software agents were used to support the assessment, identification and risk monitoring. The interaction between agents' compliance and agents has been demonstrated considering the designated rules in addition to revealing agents' reaction due to changes in project environment data. The result showed that agents were used for distinguishing risk and responding dynamically to variations in the project environment, which can aid in minimizing the human effort in managing risk. The events that affect the Agile project management practices implementation has been analyzed by Smring et al. [17] Such events in projects are those involve the new products development within manufacturing companies and provide some strategies to avoid, mitigate, and minimize the likelihood of becoming risks and its impact on the customer requirements. Risk responses and were noted to align with the purpose of the Agile practices in delivering innovative products quickly and with high-quality standards.

El-Sayed et al. (2005), a comprehensive agile model has been developed to assess and select risk based on multi-attribute evaluation methods of construction risk [2]. For this purpose, complex Multiple Criteria Decision-Making Approaches were used to calculate the determination values of optimality criterion. Fahmy et al. (2017) provided a model using the Prince 2 project management framework in Scrum methodology to improve the appropriate risk management mechanism as well as the coverage on software projects [18]. This can increase the rate of project's success and can improve quality of the product, provide a respectable estimation of the required time, and enhance quality parameters, such as the flexibility, efficiency, usability, and reliability.

3. Agile Management

Agile project management is an iterative approach to plans and implements project processes [2]. It is a set of tools and methods that are used in the development of software process, which are required for collaboration and integration between all parties through self-organization, planning, development and early delivery of the project. It is also the response to change [19]. Agile Manifesto reported that there are four values and twelve principals that Agile methods are built upon them [20]. The best way to illustrate Agile management is through (Figure 1).

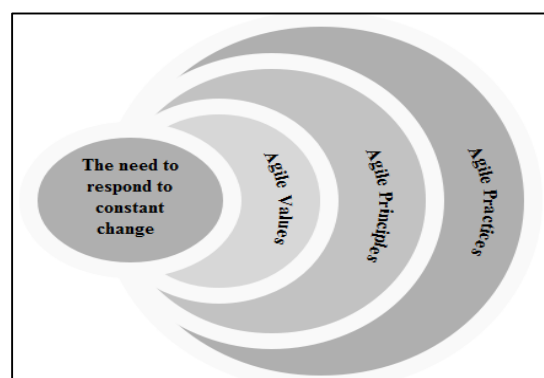


Figure 1. Agile values, principles, and practices [21]

The values of Agile statements have been put to the right and the values of traditional items to the left by many supporters to Agile methods [22]. It is noteworthy to realize that these statements are values and not prioritizations, the matters to the right side are necessary, but the left side holds greater value [23].

- Appreciate the team members and the interaction over the tools and processes they will use for work.
- Give priority to a project that work more than to have comprehensive or complete documentation.
- Give priority to deal with the customer rather than negotiating the terms of the contract.
- Preference to deal with change and interact with it to follow a specific plan.

The principles of Agile are [24-25]:

- Most priority is to the customer needs.
- Welcome changing requirements.
- Deliver working frequently.
- Projects built around the inspired team.
- Face-to-face discussion.
- The working project is an essential proportion of progress.

- Business individuals and designers must cooperate daily.
- Continuous improvement.
- Simplicity
- Agile approach encourages sustainable improvement.
- Self-organizing teams.
- Continuous improvement.

4. Common Agile Practices

Scrum is an iterative methodology for managing projects, which is the most commonly used in Agile projects. Scrum is appropriate for any project process and provides a structure for the project teams to identify and prioritize the requirements, and to focus on the subset of priority items that they think that can be delivered in each two- to four-week cycle (or “sprint”) [2]. The Scrum method is graphically demonstrated in (Figure 2).

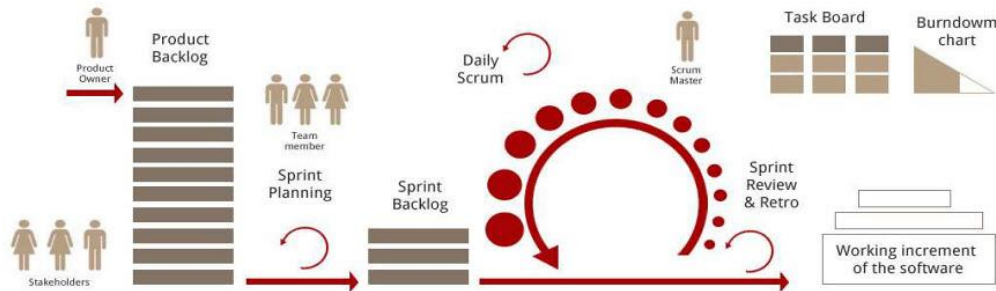


Figure 2. The Scrum processes [26]

5. Agile Management Approach for Project Risk Management

Agile management acknowledges the risks of existence and that these risks were able to be shared with every project stakeholder. Unlike traditional management that assumes the whole project risks beforehand, Agile deals with risks as they appear. Accordingly Agile management advocates has the benefit of dealing with exist risks instead of probably dealing with non-exist risks as in the case of traditional management [27].

6. Develop a Project Risk Management Framework

The proposed framework consists of three basic elements, as follows:

- Project management office: it represents the basics of the methodology of the Scrum as illustrated in Figure 1.
- Group of project management process: it represents a PMBOK guide process group (Initiation, Planning, Executing, Monitoring and controlling, and Closing), that relate to risk management.
- Functions of project management: it represents a PMBOK knowledge area (risk management), as shown in (Figure 3) that prepared by the researcher.

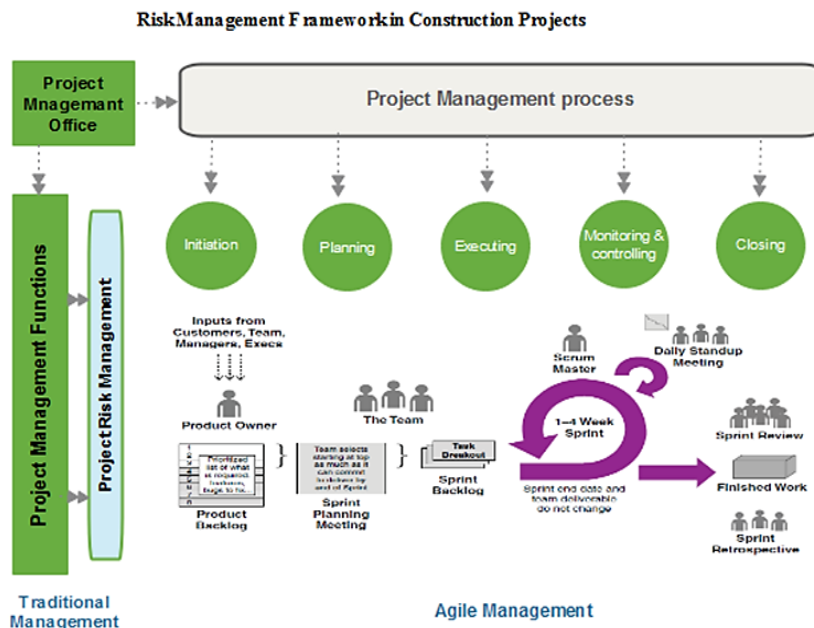


Figure 3. Agile/Traditional -Management approach

Risk management of projects incorporates the procedures of planning, identifying, response, analyzing, implementing response, and monitoring the project risk. The efficiency of project risk management is to increase the impact and/or probability of positive risks (opportunities) and to decrease the impact and/or probability of negative risks, in order to optimize the opportunities of project success [28].

Risk management of projects comprises 7 processes. In a Scrum processes, risks are reduced, as the work being conducted in an incremental series of deliverables, and implemented in very short cycles (Sprints). However, even in simple projects, items can go wrong and it is important to have a policy to address and identify risks [29].

The team in the Scrum process hold existing Agile meetings and use artifacts to manage risk. Scrum team also wait until the last responsible minute to address risk [29]. For risk management in the PMBOK® processes, inputs that can be received from the Scrum will be determined. The input maps for each process will be graphically sketched and facilitated in some detail. The details of the proposed framework will be prepared by the researcher based on the most used Agile methodology (Scrum) as clarified in the following paragraphs and shown in (Figure 4).

Plan Risk Management incorporates the process of defining how to conduct project risk management activities. The Scrum team should identify all risks that could possibly impact the project by examining from different perspectives at the project, using a different techniques (Risk checklists are a useful tool to help confirm comprehensive identification of the risk, learning from similar projects and prioritize sprints in the same project and investigating the uncertainties that affected those projects and sprints, sessions where the members of the Scrum team can openly share ideas through discussions, risk breakdown structure, and sessions of knowledge sharing).

Identification risk is implemented in Scrum processes throughout the project. It includes creating prioritized project backlog (a list of project requirements), sprint planning (the team and the project owner meets before each sprint is started to decide which the product backlog items should go into the sprint backlog), sprint review (this includes a statement of work completed in the sprint and a retrospective review of the work undertaken to enable continuous improvement), and sprint retrospective (the team, at the end of each sprint, looks back and determine if anything about the process can be improved).

Perform qualitative analysis of risk is performed with prioritizing project risks for further analysis or action by assessing their impact.

There are three options for dealing with high-risk requirements:

- High risk and high value: Move the requirements to the top of your sort or backlog,
- High risk and medium value: review the value again with the owner and see which way the requirement is leaning. If the owner leans toward high value, follow option 1. If the owner leans toward low value, follow option 3.
- High risk and low value: Move the requirement to the bottom of your sort or backlog.

The risk assessment is done with regard to proximity, probability, and impact. Risk proximity refers to when the risk might occur, while risk probability refers to the likelihood of occurring of the risks. Impact refers to the probable risk effect on the organization or the project. To estimate the risk probability, different techniques may be used, including, Pareto Analysis, Probability Trees, etc.

The response to each risk will rely upon the impact and probability of the risk. However, the Scrum iterative nature with its feedback cycles and rapid turnaround time allows for early failures detection.

Risk can be responded by executing a number of plans (proactive or reactive). The project owner to implementing agreed-upon risk response plans and reduce the risk impact or probability or both.

Monitor risk will show new risks that may be identified and assessed, thus remaining risks should be re-evaluated, and updated on the risk Burn down chart. Tracking of risks in this procedure allows the Scrum team to recognize trends in the exposure to risk and take suitable action, as necessary.

Risk refers to the factors that contribute to the success or failure of the project. On Agile projects management, risk management does not have formal risk meetings and documentation. Instead, risk management is built into roles, artifacts, and events of scrum methodology.

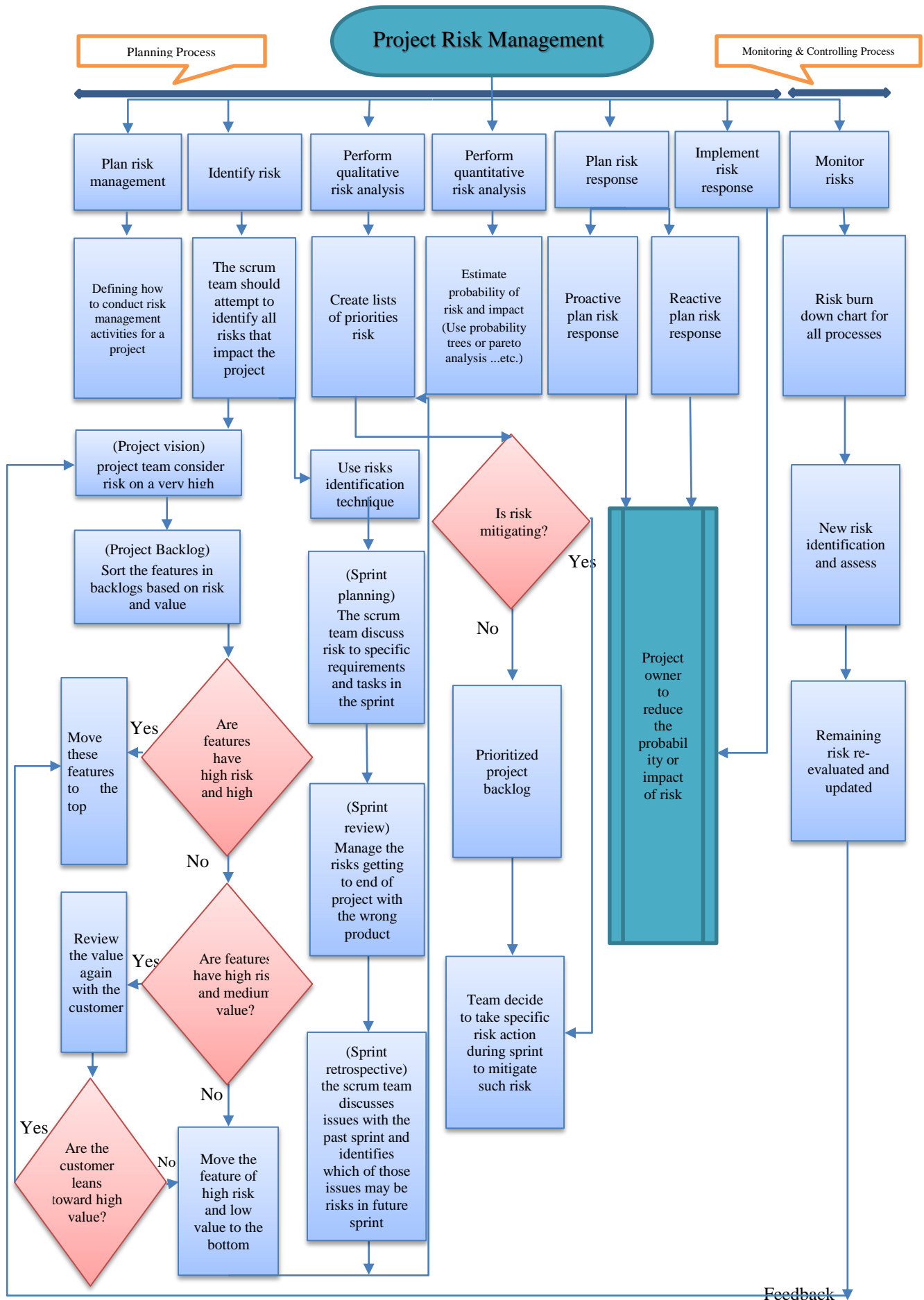


Figure 4. Risk Management Flow Chart Based on the Most Used Agile Methodology (Scrum)

7. Conclusions

Risk management benefit from Scrum method to create prioritized project backlog, sprint planning, sprint review, and sprint retrospective procedures and less time of the cycle.

- Agile management tends to be proactive in the face of risk, as the project duration is extended, the chance of risk is increased, so the division of the project into iterations, sprints reduces the chances of these risk.
- The best way to deal with risk is to face it as soon as possible, so it is very important to allocate the first iterations to address and remediate the risk
- The Scrum methodology encourages members to be general specialists team and have almost the same level of skills as anyone can share their role with anyone else, to avoid the risks associated with the absence or loss of some members of the team.
- Risk monitoring and controlling is through risk burn down chart. It is another Agile management scheme that is easy to understand. This chart illustrates the risks in the project from the outset and it naturally reduces these risks by facing them early until reach the end of the project
- Agile management focuses on the speed of the work delivery because work in progress is a risk, and whenever the faster work is done, the risk is mitigated.

The Agile principles that support risk management are:

- Most priority is to the customer needs.
- Welcome changing requirements
- Deliver working frequently
- Business individuals and designers must cooperate daily.
- The working project is an essential proportion of progress.

8. Conflicts of Interest

The authors declare no conflict of interest.

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