

# **Developing an Agile Management Framework For Project Risk Management**

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by

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## **Abstract**

Risk management becomes one of the most crucial processes in project and operation management nowadays. However, the accelerating rate of changes in project and business environment raises questions about the capability of traditional risk management processes to provide efficient performance. This paper aims to study the feasibility of using Scrum management methodology to run risk management and to evaluate the effect of utilizing agile management tools and techniques on the performance of risk management. This can be achieved through proposing a Scrum framework to run risk management application and assessing the professionals and academic perception about the proposed framework as well as the influence of using agile management tools and techniques in risk management by conducting an online survey. The survey showed a general acceptance from respondents to the proposed framework. Also, it presented a positive perception of the influence of employing agile tools and techniques in risk management processes. This paper showed theoretical support to the principle of using a Scrum framework for risk management. However, pilot projects are needed to confirm the feasibility of this proposal in real work. Also, this paper encourages further studies of the use of agile methodologies general and Scrum specifically for none software development applications.

## نبذة مختصرة

أصبحت إدارة المخاطر واحدة من أهم العمليات المرتبطة بإدارة المشاريع و العمليات حالياً. و لكن المعدل المتسارع للمتغيرات في بيئة المشاريع و الأعمال يؤدي إلى التساؤل حول قدرة و كفاءة الأنظمة التقليدية لإدارة المخاطر على التعامل مع هذه المتغيرات. في هذا البحث سنقوم بدراسة امكانية استخدام مبادئ الإدارة الرشيقة للقيام بعمليات إدارة المخاطر و تأثير استخدام أدوات و تقنيات الإدارة الرشيقة على اداء إدارة المخاطر. سيتم ذلك من خلال اقتراح إطار عمل مبني على مبادئ الإدارة الرشيقة و استخدامه للقيام بعمليات إدارة المخاطر. و من ثم سيتم إطلاق استبانة الكترونية لدراسة مدى تأييد محترفي و أكاديميي إدارة المخاطر و الإدارة الرشيقة لإطار العمل المقترح، و تصورهم عن مدى تأثير استخدام أدوات و تقنيات الإدارة الرشيقة على اداء إدارة المخاطر. تبين من خلال نتائج الاستبانة وجود تأييد عام من قبل محترفي و أكاديميي إدارة المخاطر و الإدارة الرشيقة لإطار العمل المقترح، و اعتقادهم أن استخدام أدوات و تقنيات الإدارة الرشيقة لإدارة المخاطر سيكون له تأثير إيجابي. و لكن و على الرغم من النتائج الإيجابية للدراسة، إلا أنها تبقى في الإطار النظري و هي بحاجة لعدة مشاريع اختبارية لتأكيد جدوى استخدام إطار العمل المقترح. بالرغم من ذلك، فإن هذه الدراسة تشجع على إقامة دراسات أخرى لجدوى استخدام مبادئ الإدارة الرشيقة لمشاريع ليست متعلقة بتطوير البرمجيات.

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## **1 Introduction**

All over humankind's history, acceptance of the fact that change is inevitable, flexibility, and adaptability to unexpected changes were a critical success factor for our nations' success (Meredith & Francis 2000). People used to depend on their previous experience, intuition, and common sense to plan for their future and protect themselves from the impact of ongoing changes. In the twenty-first century, traditional planning techniques are not sufficient anymore. People need to be ready to handle changes, accept it and look into opportunities in these changes and minimize threats where risk management became a primary part of every project and organization (Luna et al. 2010; Besner & Hobbs 2012).

The third millennium has brought many breakthrough events to humanity, which altered how we think about, act, and respond to changes and risks. In the early years of the new century, as a response to the changes in their field, software development professionals have introduced the concept of agile management to their field. The success stories of agile methodologies in software development projects urged professionals and academics to look into the feasibility of utilizing agile methodologies along with or to substitute traditional management practices (Silva et al. 2011). This stimulates a question of whether we can use agile methods to run risk management, and if yes, will this improve the quality of the risk management outcomes. This work was carried out to answer these questions.

### **1.1 Highlights on The History of Risk Management and Agile**

#### **1.1.1 Risk Management Flashback**

The world has known risk management since the eighth century, where for more than 200 years, risk management application was limited to the financial sector. Fifty years ago, the growing importance of risk management urged project management professionals and academics to try to introduce a standard risk management practice in their recommended and standard methods of project

management (Merna & Al-Thani 2008). The practice of risk management evolved over the years. As of today, there is almost a board consensus among professionals and practitioners that risk management has four main processes: identification, assessment, response planning, monitoring, and control (Merna & Al-Thani 2008; PMI 2009; PMI 2017; Hopkin 2017). Unlike other standard management practices, risk management is a cyclic and ongoing process, where the output of every cycle gets updated, refined and improved, i.e., risk management is a process which would occur in iteration, and its result is incremental (PMI 2009; Hopkin 2017; Gray, Larson & Desai 2013). However, there is no standard nor recommended practice for how long the risk management cycle would continue nor for how often risk management outcome (risk register) shall be updated.

### **1.1.2 Agile Management Flashback**

Urged by the incapability of conventional project management techniques and methodologies to cope up with fast pace changes in software development industries, which includes but not limited to: changes in requirements, changes in market demand, changes in technologies etc., Agile Manifesto and principles were declared in 2001 to write a new chapter in this industry (McAvoy & Sammon 2005). The new methodologies focused on delivering the software in small incremental releasable patches in relatively short cycles (Luna et al. 2010). Multiple methods were introduced under the agile family of methodologies. Some of these methodologies are focused on software development tools and techniques, while others are focused on being management methodologies for iterative and incremental projects (Barlow et al. 2011). Schawber and Sutherland, the founders of Scrum, are one of the influential voices in the industry which call for adopting agile methodologies for none software development project. They argued that their Scrum methodology is a project management methodology that would be considered applicable for any iterative and incremental application (2017). Scrum is known for its control over the time frame of each release and the processes of initiating and closing the release cycle (which is called a sprint) (Sungkur &

Ramasawmy 2014). However, is it capable of handling a critical process like risk management!

## **1.2 The Aim**

Looking into the literature and practice of risk management, it is easy to identify that there is a lack of control over the length of a review cycle of risk registers as well as the frequency of this review. This work seeks to study the feasibility of employing Scrum management methodology to perform risk management processes and to study the impact of utilizing the tool and techniques of agile management on the performance of risk management. This research would propose a theoretical Scrum framework for risk management. Then a survey will be conducted to measure practitioners and professionals' support for the proposed framework and their perception of the influence of agile tools and techniques on risk management performance.

## **1.3 Research Objectives**

- 1- Reviewing agile management literature and identifying the dominant agile methodology, its features, and its benefits.
- 2- Studying risk management literature and identifying areas of concern in the current practices and suggesting the improvement that agile can introduce in these areas.
- 3- Proposing a theoretical Scrum framework for risk management processes.
- 4- Explaining a typical cycle of the proposed framework.
- 5- Building a survey that would aim to evaluate the respondent's stand from the proposed framework and the influence of agile tools and techniques on the performance of risk management.
- 6- Conducting the survey and collecting the responses.
- 7- Analysing the collected data using the descriptive analysis and One-way ANOVA.

- 8- Discussing the outcome of the descriptive analysis and the one-way ANOVA.
- 9- Concluding on the outcome of the research work and recommending on future work.

#### **1.4 What Next?**

In the following chapter, a systematic review for the literature of risk management and agile management will be conducted, follow by a chapter on the proposed framework architecture and details. This would be trailed by a chapter which explains a typical cycle for the proposed framework. In the fifth chapter, you would be reading about the research methodology, research vehicle, and research validation. Chapter no. 6 will be dedicated to survey results analysis which will be discussed and deliberated in chapter 7. The conclusion of this works be settled in chapter 8, and research reference will be documented in chapter 9.

## **2 Theoretical Background**

### **2.1 Introduction**

Traditionally, project management was based on well-defined parameters, fully identified plans, and considerable efforts to avoid changes during the implementation. For centuries, the interest of scholars, as well as professionals, was to define and establish rigid comprehensive project management standards and reference frameworks that would guide practitioners to plan for their project management plans where changes were not welcomed at all. Nevertheless, uncertainties would always prevent any plan from being perfect where changes are a must in any project. In the 1970's, project management professionals and scholars started exploring the benefits of introducing risk management concepts, which were there in the banking and insurance field for more than 200 years. Risk management aimed to prepare professionals to deal with changes and unexpected conditions through identifying, evaluating, planning responses for, monitoring, and controlling risks (Merna & Al-Thani 2008; Hopkin 2017).

With a fast-changing world of demands and requirements, the performance of traditional project and risk management methodologies was decaying with a higher need for a more adaptable method where changes are welcomed, and plans are more flexible. It is all about being resilient to change, threats, opportunities, ...etc. Being proactive, flexible, adaptable, willing to learn, and change are the key to success in this era (Meredith & Francis 2000). In other words, to be successful in this era, you have to be agile. The software development industry was leading the change in management methodologies to overcome performance deficiencies in traditional management methodologies due to the massive amount of changes that a project would face during its lifetime. Different agile methods were introduced during the last three decades to help software development professionals improving their performance through adopting these new methodologies. Extreme programming, Kanban, Scrum are examples of these methodologies. In the following section, the literature on risk management and agile management would

be reviewed to explore its different aspects and the common areas between both fields.

## **2.2 Agile Project Management defined**

During the 1990's, software development was from the initiator of the change, introducing, adopting, and employing agile methodology concepts in their field. To establish a strong basis for their evolving methodology, and to facilitate building an agile culture among software development practitioners, in 2001, four values under the title of 'Agile Manifesto' were declared by 17 of the leaders in agile methodology. These values emphasize the importance of people, working solutions, customer involvement, collaboration, and adaptability to change over a rigid process, documentation, contract terms and conditions, and pre-prepared plans, respectively. These values were elaborated into 12 principles of agile software, which facilitates creating a common understanding of these values among practitioners (McAvoy & Sammon 2005). These values and principles were shared with the whole world through a dedicated website (<http://agilemanifesto.org>).

The ultimate purposes of agile methodology were to increase the flexibility in change management during the implementation phase, enhance the quality of response to these changes, reduce risks coming from such changes and reduce the time to market. To achieve these goals, different agile models are based on two simple principles: Small increment and Iterative work, where every iteration's works are valued and evaluated, changes are considered, risks are mitigated and a small increment of the final product is delivered to the client (Luna et al. 2010; Cervone 2011; Besner & Hobbs 2012). However, McAvoy and Sammon argued that not every project could be an agile project. They defined four categories of critical factors that determine the feasibility of an agile methodology to run a particular project. These categories were concentrated around project nature, team, customer, and organization. They suggested that to be the best fit for agile methodology, a project shall be with a short duration, medium to low criticality, and subject to change while a team shall be small, cross-functional, and highly

qualified. A customer to be preferably collocated with a project team and willing to be actively involved. Finally, an organization with an environment and culture that is agile supportive (2005). Although usually, most of a practitioner's focus would be on the factors related to a project nature, a team, and a customer, the ignored role of organizational culture has much more importance and influence on the success of agile management adoption.

Organizational culture has a crucial role in a migration trip from traditional to agile methodology. It could be a success factor or a show stopper. Workspace, processes, and even job descriptions shall be amended to suit and support migration to agile. For example, project managers have to relinquish their traditional planning and control mentality and adopt a new role, which is entirely about empowering the team and facilitating their work. A successful agile team shall be an innovative, creative, cross-functional, and self-organizing team. Ultimately, you would never gain the fruits of agile if you are looking to do agile. Companies shall change their mindsets, releasing control measures, and supporting innovation and creativity among their employees. Agility shall be part of a company strategy and a KPI for their employees. Furthermore, it is worth to be accentuated that a knowledgeable, collaborative, authorized, representative and committed customer is a keystone for the success of such migration (Nerur, Mahapatra & Mangalaraj 2005; Denning 2016; Sulaiman, Mahrin & Yusoff 2016; Eltawy & Galleary 2017).

Similar to any new concept that would be introduced to the industry, the project management community was keen to evaluate the performance of agile as an evolving methodology and benchmark it to the well-known traditional methods. Literature has documented the perceived benefits of applying agile methods since early implementation pilots. Hereunder a list of selected benefits (Solinski & Petersen 2014; Azanha et al. 2017):

- It improves knowledge sharing among a team and facilitates a shared understanding of a problem of interest.
- More efficient scope validation through short feedback cycles and continuous communication with the client.

- Better final product quality through repetitive review sessions.
- Better monitoring and control for management, which helps them to identify failure to deliver at early stages. I.e., reducing losses in case of failure.

Over the years, several agile methods were developed to assist practitioners in completing agile software development projects according to the morals of Agile Manifesto. Extreme programming (XP), SCRUM, crystal methods, Kanban, Dynamic Systems Development Method (DSDM), Adaptive Software Development (ASD), and Feature Driven Development (FDD) are instances of famous agile methods (McAvoy & Sammon 2005). These agile approaches are also considered as subclasses of Lean. This is due to the fact that it is regarded as examples of Lean thinking that share Lean concepts to promote the value, consider relatively small deliveries and elimination of waste (PMI 2017). The following section will elaborate more on each of these methodologies:

#### Crystal Methods:

It is a family of approaches (Crystal Clear, Crystal Orange, Crystal Yellow...etc.). Several aspects, such as team size, project criticality, and importance, would define a proper Crystal classification for each project based on rules of thumb. Lack of scalability and support to non-co-located teams and systems which are classified critical systems are few weaknesses for this method. Considering its drawbacks and the fact that crystal methods have a varied range of strategies that were presented to satisfy the classifications of the projects according to crystal methods factors, it would be difficult and intricate to utilize it for risk management application (Fustik 2017; Rajagopalan & Mathew 2016).

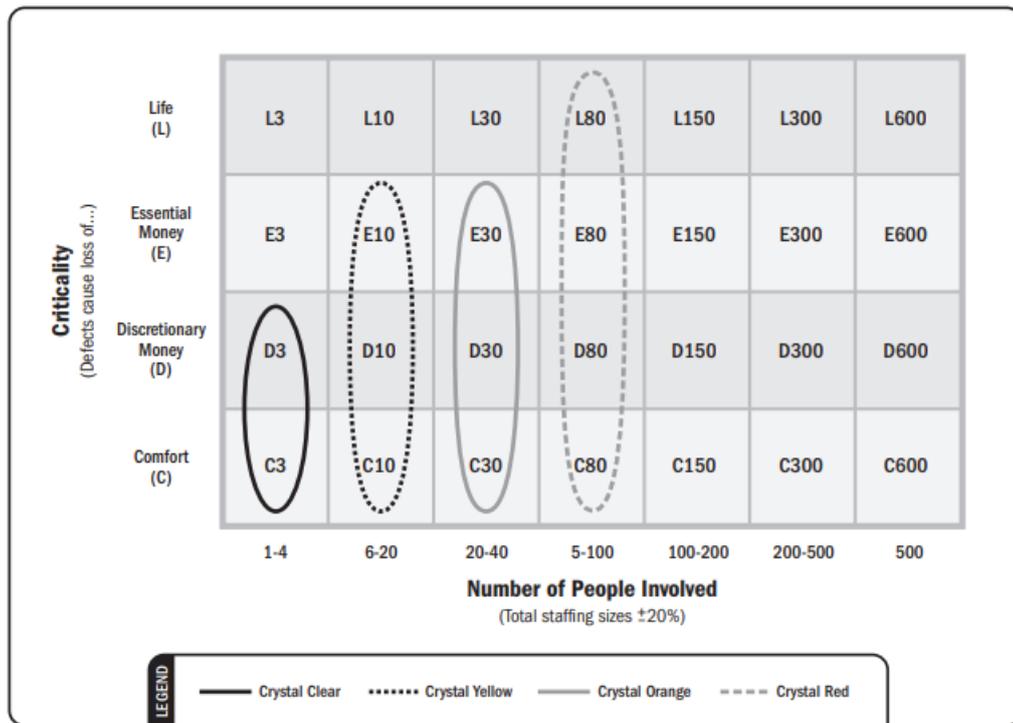


Figure 1: Categories of Crystal Methods (PMI 2017, p.106)

#### Kanban:

Kanban is a method that stresses on steps which a project or feature passes through during its production. Then, design a workflow that aims to help to improve and to ensure the continuous delivery of a production system. This approach is based on three basic principles: simulating and conceptualizing of workflow, planning to limit the ongoing works, and continuous delivery when a product / a feature is completed, the next one is into production. Kanban board is a means which assists practitioners to understand the flow of work and identify potential bottlenecks (Fustik 2017). Since risk management is a structured process that has clear phases, the use of the Kanban method would be beneficial and would help risk management practice to be more focused on workflow and bottlenecks. However, Kanban by itself would not be sufficient to provide a targeted improvement to risk management practice (Fustik 2017).

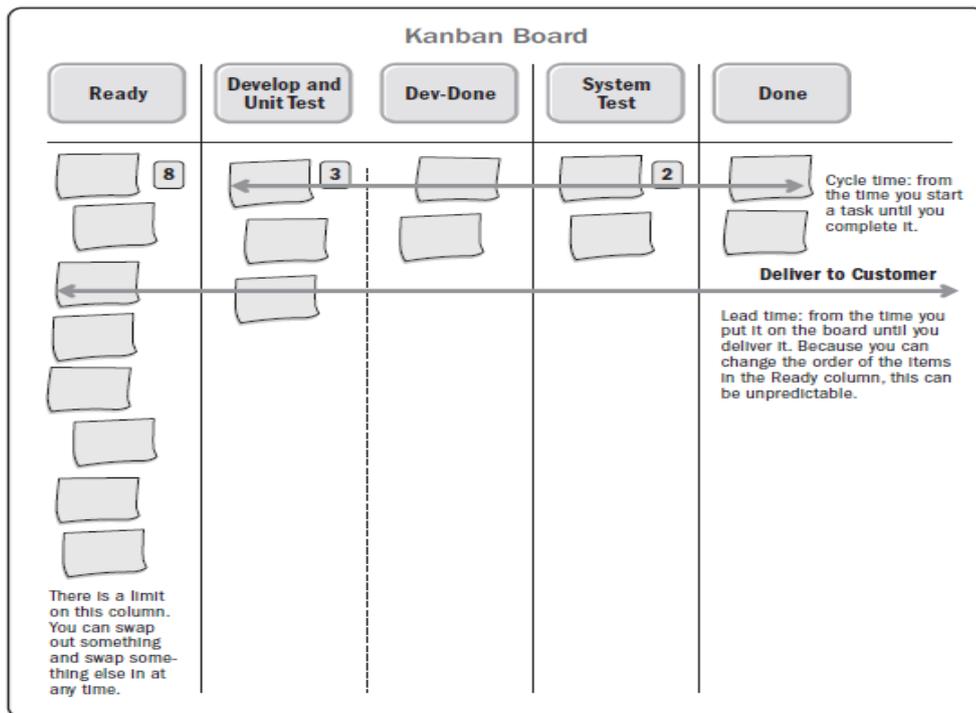


Figure 2: Sample of Kanban Board (PMI 2017, p.65)

Dynamic Systems Development Method (DSDM):

Dynamic Systems Development Method (DSDM) is an incremental and iterative method that initially aimed to provide a sort of strictness to Rapid Application Development (RAD). In DSDM, cost, time, and quality are non-negotiable constraints. While the scope is subject to prioritization using ‘MoSCoW’ rules. These rules define what Must be there in scope, what Should, Could, and what won’t be there within a cost and time set limits and with a preset level of quality. DSDM is well known for its sophisticated and costly implementation, which might not be feasible for small organizations and makes it a none preferred choice to utilize for risk management applications (Khare & Shrivastava 2015; Rajagopalan & Mathew 2016; Fustik 2017).

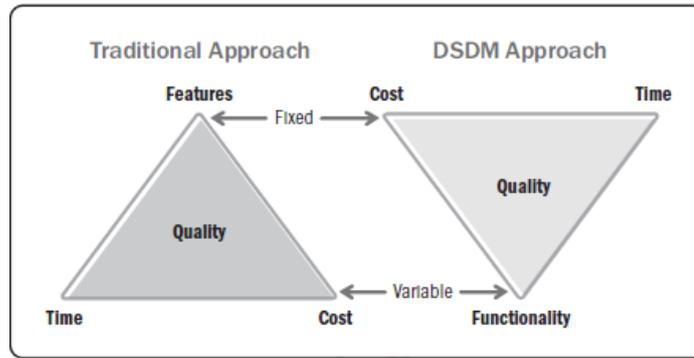


Figure 3: DSDM Approach (PMI 2017, p.110)

#### Adaptive Software Development (ASD):

Adaptive Software Development (ASD) is a repetitive series of speculation, collaboration, and learning cycles. Mission-oriented, iterative, feature-based, time-limited, change tolerant, and risk driven are the significant characteristics of this method. However, this method is not practical when it comes to interaction with external parties. Also, it lacks a proper focus on practices rather than theories, which makes it unsuitable for risk management applications (Khare & Shrivastava 2015; Rajagopalan & Mathew 2016; Fustik 2017).

#### Feature Driven Development (FDD):

Feature Driven Development is an incremental and iterative software development approach, which emphasizes quality, tangible, and frequent deliverables through short iterations. Irrespective of the short length of an iteration, the delivered feature must be recognized by the client as a valued one. This method is best utilized in improving the quality of an existing product by adding a new feature at the end of each iteration. Nevertheless, it does not satisfy the necessary risk management requirements of continuous monitoring of all risks. Hence, it is not the best fit for risk management applications (Khare & Shrivastava 2015; Rajagopalan & Mathew 2016; Fustik 2017).

Extreme programming (XP):

It is one of the very first agile methods that were introduced in the software development industry. It focuses on enormously well-organized and strict programming practices that strive to reduce the required span for production and to deal with frequent changes in the requirements. Pair programming is one of the practices which was introduced by Extreme Programming (XP) methodology. Similarly, there is unit testing, refactoring, planning games, and continuous integration. However, it lacks the consideration of project management processes, which would not make it the optimum methodology to run risk management applications. On the other side, XP methodology has efficient techniques like: pair programming and planning games, which could represent a high added value to any risk management practice (Rajamanickam 2005; Hummel 2014).

Scrum:

Scrum was introduced in the 1990s by Schwaber and Sutherland, who defined Scrum as “a framework for developing, delivering, and sustaining complex products” (Schwaber & Sutherland 2017, p.3). It was presented for the first time at the OOPSLA conference in 1995 as an “iterative approach, with incremental optimization of predictability and control risk” (Azanha et al., p.7). To help others understand their framework, Scrum creators introduced a guide which they call ‘The Scrum Guide,’ and they shared it on the internet to be available for everyone who seeks knowledge about Scrum. Different from the other agile methodologies, Scrum was not introduced to be another software development method. In contrast, it was defined to fit whatever might be considered a complex product. This product might be software or hardware, tangible or intangible, ...etc (Schwaber & Sutherland 2017). The generic nature of this method and its focus on activity management rather than the steps of the activity itself, make it the best choice to run risk management applications.

Over the last couple of decades, literature was abundant studies aim to assess the different agile methodologies and benchmarked it to each other, where the focus was on its performance in software development projects. A systematic review of

the literature was performed by many scholars showed that SCRUM and XP are the most often utilized agile methodologies. Unlike XP, SCRUM focuses on the agile project management process and how to run it, whereas XP focuses on software development techniques and procedures. Due to the fact that, especially in the first decade, software development project performance was the point of interest, literature is more abundant with articles discussing Extreme Programming (Cervone 2011; Barlow et al. 2011; Jalali & Wohlin 2012; Hummel 2014; Khare & Shrivastava 2015; Rajagopalan & Mathew 2016; Tarwani & Chug 2016).

Because of the well-documented improvements which were brought to software development projects by using these methods, it attained scholars' and experts' interest to explore it, improve it, and encourage its use as a project management methodology that can be used as applicable. This is where Scrum with its proven records of success, became the most popular and dominant agile project management practice (Rasnacis & Berzisa 2015; Henriques & Tanner 2017; Cervone 2011). Since this research work is interested in agile as a management method, more attention will be offered to Scrum as the leading agile management methodology.

## **2.3 Scrum**

### **2.3.1 Introduction**

Schwaber and Sutherland introduced Scrum as an iterative and incremental approach whose focus is to optimize the way the member of the project team handles its ambiguity, changes, chances, and threats that might arise through the project. Scrum, as defined by its creators: Schwaber and Sutherland, is built on transparency, adaptation, and inspection as the three pillars of Scrum. Transparency implies that the works must be visible to and understood by everybody involved in this job, where the professional language they use, their terms, and expression should be universal. All of them must possess the same definition of “Done.” While inspection pillar guides practitioners to the importance of getting their progress toward their interim goals inspected regularly by specialized assessors to detect unwelcome variances. If the result of an inspection cycle showed that any aspect of the process was recognized to be beyond the adequate limits by a professional inspector, immediate actions must take place to adjust the alteration and reduce any potentials for further nonconformity, which represents the pillar of adaptability (Schwaber & Sutherland 2017).

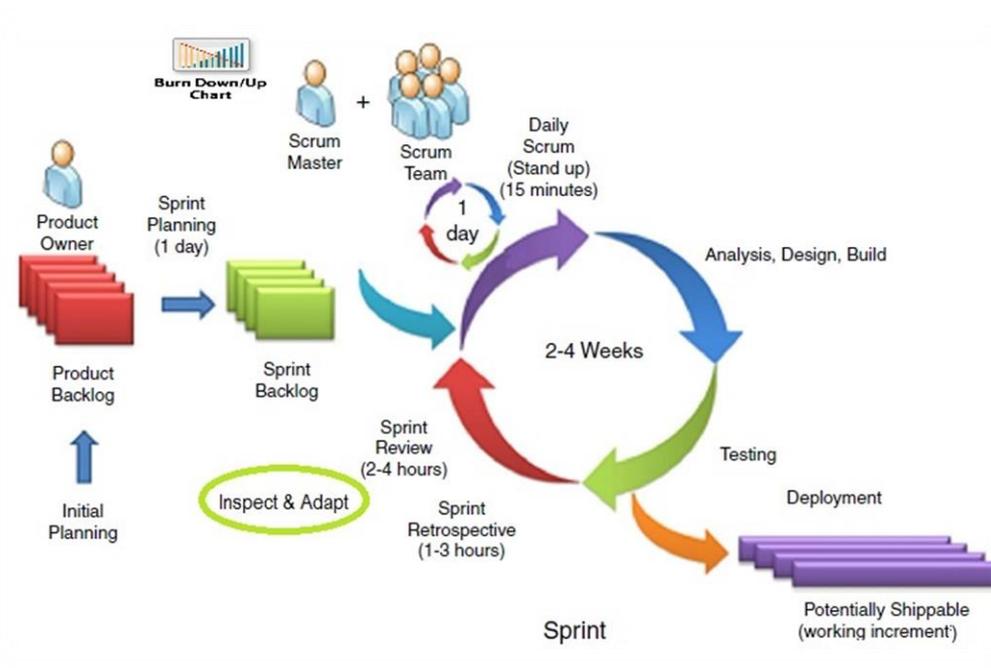


Figure 4: Typical Scrum Cycle (Adapted from Azanha et al. 2017)

Scrum framework life cycle, as illustrated in the figure, consists of a combination of iterative timelimited events called Sprints. Sprints are managed by Scrum team members via a number of timelimited events that are repetitive in each Sprint. The output of a Sprint is treated as a step toward the final product.

### 2.3.2 Scrum Artifacts:

Product Backlog:

It is a record of requirements that summarizes whatever intended to be in the ultimate products. However, it has to be ordered. The creation of product backlog, its items' order, priorities, and changes are the sole responsibility of the Product Owner. Due to the fact that agile projects requirements are never complete at the beginning, product backlogs are dynamic documents, where changes are always welcomed as long as it serves the project purpose. Furthermore, product backlog list items are not a single line item list. On the contrary, each item in this list shall be well defined by its attributes: description, estimate, order, value, and its 'done' definition (Schwaber & Sutherland 2017).

### Sprint Backlog:

Sprint backlog is a subset of product backlog that are selected to be implemented in a Sprint, associated with its implementation plan for the Sprint targeted increment and how to realize the Sprint goal. In a particular Sprint, selected backlog items are fixed and not subject to change. However, the work required to deliver the sprint backlog is flexible and dynamic, where a development team can add, remove, or alter it as necessary. The criteria for the successful delivery of a Sprint backlog is to achieve a usable and releasable increment that satisfies the Sprint goal (Schwaber & Sutherland 2017).

### Sprint Goal:

“The Sprint Goal is an objective that will be met within the Sprint through the implementation of the Product Backlog, and it provides guidance to the Development Team on why it is building the Increment” (Schwaber & Sutherland 2017, p.11).

### Scrum Team:

Scrum team is a creative, flexible, productive, cross-functional, and self-organizing team. Three roles are there in a Scrum team: a product owner, a Scrum Master, and the development team (Schwaber & Sutherland 2017; Cervone 2011; Sungkur & Ramasawmy 2014).

### Product Owner:

A product owner is a sole person in charge of and accountable for handling and managing the product backlog. This includes:

- 1- Identifying backlog items clearly.
- 2- Ordering the sequence of implementation of product backlog items and expressing priorities.
- 3- Ensuring visibility, transparency, and clarity of product backlog items to all Scrum team members and that it shows what to be done next.
- 4- Ensuring that the development team has the required level of understanding for backlog items.

#### 5- Optimizing and maximizing the value of the development works.

Since the product owner is the ultimate accountable and responsible individual for the success or failure of the product, his/her decision must be respected not only by Scrum team, but also, the whole organization (Schwaber & Sutherland 2017; Cervone 2011; Sungkur & Ramasawmy 2014).

#### Scrum Master:

Scrum Master is in charge of encouraging and promoting the Scrum process implementation. Scrum Master role is different from a conventional project manager where his/her primary role is not about controlling works in progress. Instead, Scrum Master seeks to help everyone in the Scrum team to understand his/her role and how to interact with other team members. Moreover, this role aims to optimize the process implemented by the Scrum team and the interactions within and with the Scrum team. Additionally, he/she is not only helping by coaching the team members for a better implementation of Scrum but also offering technical support to them to ensure that they are doing their works up to level best. Eventually, Scrum Master has a significant value in his/her organization as well, as this role is all about leading, coaching, and supporting the organization for better implementation and practice of Scrum. In simple words, Scrum master is the Scrum mentor in the project as well as in the organization, who is responsible and accountable for the successful implementation of Scrum methodology through facilitating, coaching, and mentoring but not controlling the project team. Scrum master shall support the team to improve their performance and to overcome hindrances without neither questioning their qualifications and performance nor controlling the way they perform their work. On the contrary, Scrum master shall support and protect the independence of the project team. Unlike the traditional role of a project manager or risk manager, Scrum master role is responsible and accountable for the process but not the results which would be the responsibility of the product owner and development team (Schwaber & Sutherland 2017; Cervone 2011; Sungkur & Ramasawmy 2014; PMI 2017)

The Development Team:

It is a self-disciplined, structured, authorized, and cross-functional team, where there is no one with a title, no sub-team, and the accountability is owned by the whole the team as a unit. The optimum size of these teams is 3-9 members, without considering the role of the Scrum Master and the product owner (Schwaber & Sutherland 2017; Cervone 2011; Sungkur & Ramasawmy 2014).

Scrum Events:

Considering the importance of efficient detection of variances from the predetermined Sprint goals, there are four formal events identified in each Sprint as a part of Scrum typical practices, which are: Sprint planning, Daily Scrum, Sprint review and Sprint Retrospective (Schwaber & Sutherland 2017). Trust, Transparency, and progress visibility are coming benefits for Scrum Events (Alsahli, Khan & Alyahya 2017).

The Sprint:

“The heart of Scrum is a Sprint, a time-box of one month or less during which a “Done,” useable, and potentially releasable product Increment is created” (Schwaber & Sutherland 2017, p.9). Through a Sprint, its predefined goals are not subject to variation or modification, and quality standards are none-negotiable. Nevertheless, Development Team may elucidate or renegotiate the given scope with the product owner as more is learned. Moreover, the Sprint may be called off by the product owner in case its goals found to be abandoned (Schwaber & Sutherland 2017).

Sprint Planning:

A time-restricted meeting that has an extreme of eight hours for one-month Sprint and shorter for shorter Sprint. During the session, a Scrum team works collaboratively to outline the deliverables of the upcoming Sprint and how to achieve the crucial works to provide the agreed releasable outcome. The nominated product backlog items to be carried on throughout the forthcoming Sprint in

addition to its delivery plan form together the Sprint Backlog (Schwaber & Sutherland 2017; Sungkur & Ramasawmy 2014).

#### Daily Scrum:

A 15-minute time-restricted meeting that takes place daily. It is to be attended merely by the Development team where they would discuss their achievements in the past 24 hours, their plans for what to accomplish during the coming 24 hours, and any anticipated impediment or showstopper that might prevent them from delivering the Sprint goal. The comprehensive discussion of any suspected hindrances and its mitigation plan would be carried on in a distinct meeting (Schwaber & Sutherland 2017; Sungkur & Ramasawmy 2014).

#### Sprint Review:

A time-restricted meeting with a duration of four hours for a one-month Sprint and relatively shorter for a shorter Sprints. Sprint review takes place at the end of every Sprint, where the product owner invites the Scrum team and imperative stakeholders to attend. It aims to inspect the output of the Sprint, i.e., the increment, and amend the product backlog if required. During the Sprint review, the following would take place:

- 1- Reviewing what has been done and what has not of the product backlog. The product owner might discuss this in details if required.
- 2- Debating on the ups and downs of the Sprint and how the development team handled the problems they faced.
- 3- An increment demonstration by the development team, followed by Q&As.
- 4- Revising the planned dates of the product backlog items according to the achieved progress rate.
- 5- Defining generally the outline of the upcoming Sprint goal which would represent a contribution for the next Sprint planning meeting.
- 6- Re-evaluating the feasibility of the ultimate product as of todate marketplace conditions.

- 7- Revising the project baseline and the anticipated marketplace for the upcoming planned releases (Schwaber & Sutherland 2017; Sungkur & Ramasawmy 2014).

#### Sprint Retrospective:

A time-restricted meeting of three hours duration for a one-month Sprint and relatively shorter for a shorter Sprint where it is the Scrum master responsibility to ensure that this meeting takes place and its purpose is understood by all attendants. It represents an internal audit gateway where the whole team discusses how they performed from people, process, relationship, and tools perspective, what the potential enhancements are and what is its delivery plan. The Scrum Master would take the chance to encourage Scrum practice improvements. A Sprint retrospective meeting takes place after the Sprint review and prior to the upcoming Sprint planning event (Schwaber & Sutherland 2017; Sungkur & Ramasawmy 2014).

## **2.4 Agile Practices and Techniques**

Although SCRUM focuses only on the management aspect of agile management, companies, and teams who are adopting SCRUM agile management are utilizing different agile practices and techniques which were developed under other agile methodologies. In the following sections, the most common agile methods in the industry will be summarized.

### Pair Programming

It is also known as ‘peer programming.’ This practice is based on the concept of a ‘second pair of eyes’ all over an activity. To ensure this, two programmers are involved in each activity. The driver, a programmer who is writing the code, will be focused on the technical part of the activity and how to produce a code that delivers the required result. While he is completely engrossed in this, the navigator, a programmer who overlooks the works of the driver, will have a helicopter view on what is going on. A navigator should be concerned about the synthesis of the

code under production with the previous pieces of codes that were generated earlier and what the next step is. Additionally, the navigator will be checking the quality of the code under production to make sure that the driver doesn't miss or miscode any part of the code accidentally. I.e., a driver will be thinking tactically while a navigator will be thinking strategically. Over time, a switch of responsibilities shall happen to ensure a dynamic and active improvement of work without stepping into a monotone process (Shone & Warden 2008; Haines, Idemudia & Raisinghani 2017; Kongyai & Edi 2011). Pair programming concept is also applicable and could be used in risk management as well. From a risk management perspective, the driver will be looking to define threats and opportunities in the area of concern, where the navigator will be checking the effect of the identified risks on other areas and whether the newly defined risks will trigger risks in other areas or change its probability and impact.

Such a technique would help the team to guarantee a continuous quality audit is taking place for each and every piece of code that is under production. Moreover, working in pairs would improve and encourage knowledge sharing and continuous skills improvement throughout the project life cycle. However, this might harm the whole project if the pair selection was not proper. A simple way to avoid this is to allow the teams to be formed naturally without going against individual preferences of their partners. Doing this, the team's synergy would be guaranteed (Shone & Warden 2008; Haines, Idemudia & Raisinghani 2017).

### Refactoring

The concept of refactoring is based on the idea that among multiple ways of achieving a goal, there is one preferred way. However, it is not always the same. In a refactoring process, the programmer would change the design of the code without changing its function. Refactoring helps programmers to obtain the optimum design of their code and to avoid code duplication, inaccurate formats, null codes, ...etc. Refactoring shall not be thought of as a rework. It is an improvement of a code design to fit its purpose (Shone & Warden 2008; Haines, Idemudia & Raisinghani 2017; Kongyai & Edi 2011).

Refactoring is a parallel process to code writing, where it could be performed with every feature developed and regularly during the production of the code. This would help to create more efficient and agile code. Nevertheless, the programmer shall not overthink the refactoring process. Otherwise, it would be a time-consuming task, and it might be costly if performed in a wrong manner (Shone & Warden 2008; Haines, Idemudia & Raisinghani 2017; Kongyai & Edi 2011). In risk management, refactoring is applied even if it is not named, where risk management practitioners would change the design of the risk management process to fit the area /project of concerns through selecting the most appropriate risk management tools, techniques, and risk register format to be used for a particular area. This always helps to improve the quality and efficiency of risk management. Such a concept is considered one of the critical success factors in risk management (PMI 2009).

#### Ubiquitous Language

It is a universal language between who owns the requirements and who owns the implementation, which must be there to ensure the successful implementation of the project. To achieve this, implementation teams shall develop a language term that describes their work in and can be understood by domain experts or whoever owns the requirements. The successful implementation of this concept would guarantee that an implementation team understands clearly the requirements, and domain experts or requirements' owners can understand and answer any concern raised by the implementation team as well (Shone & Warden 2008). PMI has emphasized the importance of a common language and a shared understanding of risk management expressions and terminology to the success of the overall risk management practice (2009).

#### Active Client Involvement

Active client involvement is one of the critical pillars for a successful implementation of agile methodology. Clients shall be actively and energetically involved in all phases of a project, starting from requirements, through testing

before interim releases and up to the final release of the project. This would help to ensure that whatever is developed in each sprint or cycle is exactly what a client wants. Yet, it could have a massive negative impact on the project if the wrong personnel were selected (Shone & Warden 2008; Haines, Idemudia & Raisinghani 2017). The importance of active client involvement is not any less in risk management. The active involvement not only from a client-side, but from all internal and external stakeholders are a major pillar to the success of risk management practice (PMI 2009; Hopkin 2017; Merna & Al-Thani 2008).

### Information Sharing

Transparency is one of the three pillars of Scrum. As such, Scrum teams shall ensure that they are taking all the measures and the required actions to maintain a transparent work environment. Scrum teams are urged to maintain up to date information about their related tasks where every team member, as well as client representative, will be aware of project status. A burnup diagram, a burndown diagram, a Kanban board, and cumulative diagrams are means by which Scrum teams can ensure that other team members, stakeholders, ...etc. are fully aware of the project's current status and updates as applicable (Schwaber & Sutherland 2017). These diagrams and tools, in addition to being standard agile information sharing tools, are efficient team communications tools that represent one of the critical success factors of risk management as PMI defined them (PMI 2009). Nowadays, multiple tools could assist a Scrum team or, generally, an agile team to manage their project. Atlassian JIRA, Asana, Version One, Taiga, and Assembla are a few examples of popular agile tools in the industry (Manole & Avramescu 2017).

### **2.5 Informative Workspace – Information Radiators**

One way of keeping the people engaged in a project and up to date with its status is to share all the necessary information with them continuously. Nevertheless, reports, email, memos, ...etc. are, to some extent, monotonous media to broadcast

such information. People would not be interested in reading a few pages report looking for a piece of information which they want. Information shall be offered in a more attractive media to grab the individuals' interest. Workspace is the best area where you guarantee that your team will be attractive to any change in its environment because it is like home for them. That is why using information radiators in a workspace is the best method to update your team and ensure that active engagement (Shone & Warden 2008).

Information radiators could be any media in any form or format which contains information that you would like to share with the team. It could be an LCD screen, whiteboard, a piece of paper mounted on the wall, ...etc. It could be used to keep the team informed, to update the team, and in the best scenarios for the team to update the status of the project minute by minute. Thus, you need to ensure the teams' support and active involvement to obtain the aimed results. Otherwise, people might consider it as another control measure that is used to micromanage them and add another tedious task to their daily routine (Shone & Warden 2008).

Release plan and a team calendar are two examples of information radiators that could be updated every month which makes it suitable to be shown on LCD screens or printed on a piece of paper and mounted on the wall without being worried about the next update. On the contrast, a whiteboard might be considered the best media for the dynamic charts which could be updated daily where the team plays a vital role in maintaining the up to minute details on these whiteboards. The followings are a few examples of what information radiators could be used for and what type of information can be shared through such media (Shone & Warden 2008).

#### Burndown Charts:

In burndown charts, a team would measure the actual remaining works compared to the planned one against time. This would help them to measure the progressing speed, delivery at risk, and the anticipated date of completion. It could be represented as a line chart or bar chart against time. A burndown chart represents the team eye on their progress and their tool to ensure successful delivery for their

targets. However, this requires their commitment to keeping the charts updated with accurate information promptly (PMI 2017).

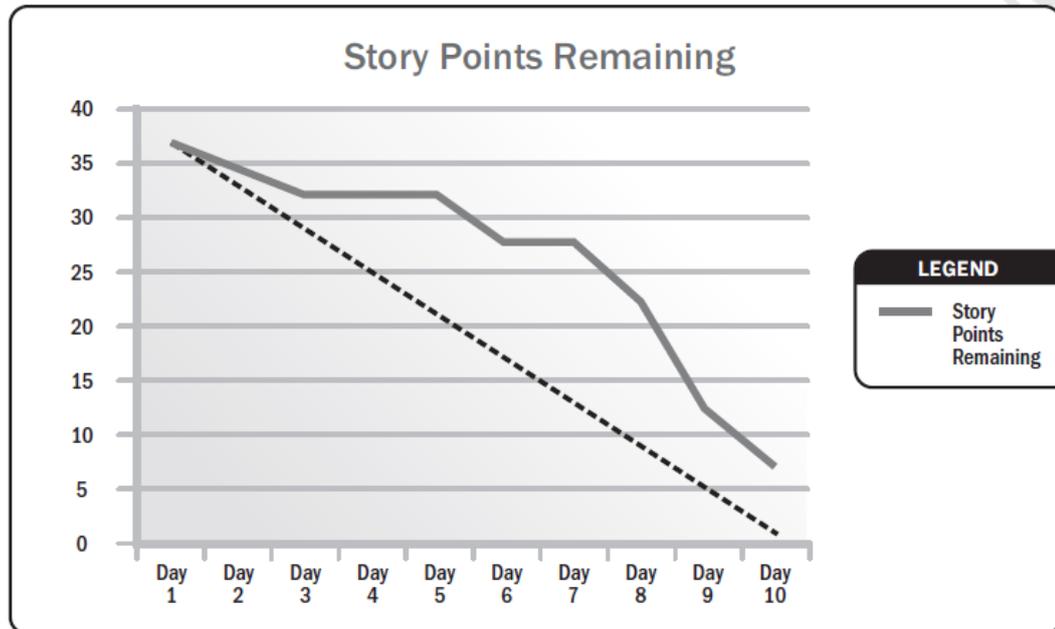


Figure 5 Sample of Burndown chart (PMI 2017, p.62)

#### Burnup Chart:

Its concept is almost similar to burndown charts. However, it measures the work accomplished to date against the planned one. Both burndown and burnup charts for each release represents a valuable input data for the next release planning, as it would help the product owner and the rest of the team to have a more accurate estimate for the amount of work that could be accomplished in every release cycle (PMI 2017).

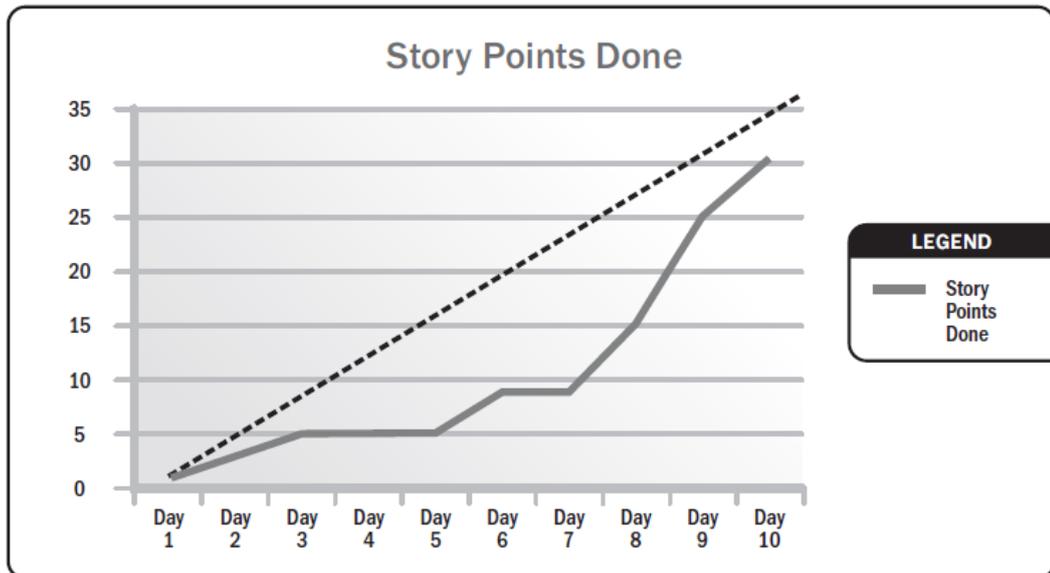


Figure 6 Sample of Burnup chart (PMI 2017, p.63)

### Kanban boards

Although a Kanban board originally is based on Kanban agile methodology, it is widely used in other methods, especially Scrum. The Kanban board is a reliable visual media that would help any individual, even if he is not a project member, to visualize and have an idea about the workload distribution among the different phases, the amount of work in progress, and bottlenecks. An example of a Kanban board was shown earlier (PMI 2017).

The flexibility of this information radiator is the source of its strength, where it could be used to measure story points, features, percentages of completion, ...etc. The most efficient format of such radiators shall be defined by the project team themselves to ensure their interest in keeping it updated accurately and timely. Furthermore, such charts shall be used merely by the team to communicate and update each other. But it should never be used to evaluate the team's performance or to build the official reporting based on. It shall be maintained as a means of communication between team members only to obtain its maximum benefit (Shone & Warden 2008).

The sense of information radiator applies to whatever field, which requires the different stakeholders to be fully informed and aware of a certain topic. In the risk

management field, and information radiator could be of help to keep the team engaged and aware of the current situation. For example, LCD could be used to promote the risks related to personnel health and safety, burnup and burndown charts could be used to reflect the progress of risk identification in a particular area, and Kanban boards could be used to indicate the status of the triggered risks and their response plan. These are only examples. However, the risk management team would select the best means of information sharing based on the criticality of the information and process needs.

## **2.6 Project Risk Management**

### **2.6.1 Risk: the roots of the word**

‘Risk’ as a word was introduced to the English language coming from the French word ‘risqué’ in the 17<sup>th</sup> century, where the French word has primarily a negative implication., but rarely positive. Nevertheless, the English word has an absolute negative indication. The first half of the 18<sup>th</sup> century witnessed the early usage of the Term ‘risk’ in financial transactions, especially insurance (Merna & Al-Thani 2008). “The Oxford English Dictionary definition of risk is as follows: ‘a chance or possibility of danger, loss, injury, or other adverse consequences,’ and the meaning of at risk is ‘exposed to danger’ (Hopkin 2017, p. 15).

In professional life, the term ‘risk’ was utilized to measure the probability of a particular outcome, mainly, negative and the anticipated impact of this outcome. The literature is abundant in definitions of risk from a different perspective. However, mostly, the concept of risk was attached to the concept of ‘uncertainty’ (Merna & Al-Thani 2008; Hopkin 2017; Perminova, Gustafsson & Wikström 2008). Frank Knight was one the leaders to draw the thin line between risk and uncertainty, where the possibility to estimate the probability of an event is this thin line, which moves the uncertainty to risk (Knight 1964). Over the years, scholars never agreed on a specific definition of risk and uncertainty. Project Management Institute (PMI) specified that risk might have a positive or negative impact. Nevertheless, they considered risks as an effect of uncertainty (PMI, 2013). ISO Guide 73 and ISO 31000 emphasize this concept in their definition of risk as a consequence of uncertainty on objectives that might have a positive or a negative impact (Hopkin 2017; AIRMIC, ALARM & IRM 2010). Also, the Committee Of Sponsoring Organization (known as COSO) framework showed another perspective indicating that risk is always associated with negative consequences, opportunities are linked to a positive impact, and the uncertainty is the summation of risk and opportunity (COSO 2004). Even though all the previous definitions of

risk and uncertainty formed a direct relationship between both concepts, there is another trend in the literature presented by Rafferty in 1994 and cited by Merna and Al-Thani as he proposed that risks are quantifiable, could be assessed statistically and it is built based on hard data. While, he suggested that uncertainty is not quantifiable, judged subjectively, and developed based on informed opinion (2008). In this article, we will adopt the risk definition of PMI as the combination of threats and opportunities and a result of uncertainty.

## **2.6.2 Risk Management**

Although risk as a term was there for more than two decades, risks used to be considered as a negative aspect that shall be avoided. Discussions about risk and its management among professionals and scholars were superficial and focused on terminologies and thought more than being focused on management and control. The formal birth of risk management in the twentieth century was support and built on the development of the usage of probability in management theories. Modern risk management was appropriately introduced to the literature in the 1950's after World War II, where it was focused on addressing the financial and commercial risks, especially in contracts. Almost two decades later, in the 1970's, project risk management was recognized as one of the necessary tools that a successful project manager should possess. During the 1980s & 1990s, project risk management literature was growing rapidly, drawing the attention of more scholars and professionals who participated in developing risk management terminologies, processes, and standards that we have today (Merna & Al-Thani 2008; Dionne 2013).

### **2.6.2.1 Risk Management Artifacts**

Over the years, scholars and practitioners enrich risk management literature with many perceptions and artifacts, which would help to improve risk management practice. Risk management artifacts understanding and digesting is a significant

milestone toward a successful implementation of risk management principles. The following lines introduce the most common risk management artifacts:

- Project risk: “an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives” (PMI 2013, p. 310).
- Risk management: The process of identifying, assessing, analyzing, documenting risks. Then, planning and taking actions toward strengthening opportunities and mitigating threats. Its star feature is that it is an iterative and incremental process with infinite loops of reassessing, improvement, monitoring, controlling, and communicating, and it is everyone’s job (Merna & Al-Thani 2008; Hopkin 2017; Perminova, Gustafsson & Wikström 2008; PMI 2013; PMI 2009).
- Risk appetite: it represents an amount, level, and type of risk that deemed to be acceptable to the authorized entity and might be taken on in the pursuit of anticipated benefits (Collier 2009; Hopkin 2017; PMI 2013).
- Risk tolerance: it is a measure of the amount, level, and type of risk with which the preset project/organization objectives, goals, or deliverable would be still achievable (Collier 2009; PMI 2013).
- Risk exposure: it represents the total amount of risk to which an entity is exposed at a particular moment of time. It might be measured on risk by risk basis or the total level of all risks (Hopkin 2017; PMI 2009).
- Risk threshold: it defines a limit of risk exposure after which risk mitigation plan shall be activated (Hopkin 2017; PMI 2013; PMI 2009).

#### **2.6.2.2 Risk Management Practice and Risk Culture**

Although the literature is heavily loaded with many risk management standards which have different names, issued by different entities and followed by a various audience, the main steps to manage any risk are almost the same, which can be summarized as (Collier 2009; PMI 2013, PMI 2009):

- 1- Plan risk management and make sure to define risk management general parameters: risk appetite, tolerance, threshold, ...etc.
- 2- Identify risks, risk owners, list it, and establish your risk register.
- 3- Assess and evaluate the impact of identified risks and their likelihood.
- 4- Rank the identified risks based on their severity.
- 5- Plan risk response plans for each of the identified risks and identify risk action owners.
- 6- Plan your contingency based on information available about the project and the identified risks.
- 7- Update your risk register and communicate it among project stakeholders.
- 8- Keep monitoring, updating, and communicating your risk register within a reasonable time cycle.
- 9- Once a risk threshold is identified, activate your risk response plan and its control measure.
- 10- Once risk mitigation action is completed, measure residual risks, and add it to the risk register.
- 11- Keep monitoring, updating, and communicating your risk register.

Unfortunately, these steps are not sufficient by themselves to guarantee proper risk management practices. There are three factors for a successful implementation of risk management (Merna & Al-Thani 2008; Hopkin 2017; PMI 2009):

- 1- An organization should have a robust risk-aware culture, which will reflect the same to any project implemented by the organization team. Adopting agile methodology would guarantee a specific limit that each and every single member of the organization is involved in one cycle of risk management cycle, which would enhance their awareness and increase their active involvement.
- 2- Risk governance which should be mutually accepted by management as well as employees.
- 3- Well-trained employees who are actively involved in risk management activities

Building risk-aware culture is not an easy task, where risk management in charge within the organization shall pay intensive efforts and work hard to make sure that the organization is moving toward a positive risk-aware culture at all levels: project, program, portfolio, and enterprise. Risk management in charge must define what barriers are there, and take the necessary actions to overcome these barriers and build a robust risk-aware culture. Hereunder few obstacles and actions which are documented in risk management literature and an envision on how agile could help in such matter (Merna & Al-Thani 2008; Hopkin 2017):

- 1- Arrange different risk management awareness and training sessions for all levels within an organization. Content should be adjusted to the targeted level of awareness for each category of employees. This would help to establish a common understanding, language, and expectation of risk management.

Agile added value: Agile is a team-oriented structure where teams are self-organized and multifunctional, which supports knowledge sharing among team members. Such an arrangement would help to get every single team member to be well trained directly from his expert colleagues. This would increase proficiency and team spirit.

- 2- Risk management in charge should identify a member of the senior management who is most likely to support risk management within an organization as a risk management sponsor. Risk management in charge shall make sure that risk management plans, priorities, and goals are to support and in line with the vision of risk management sponsor. This would guarantee the necessary support from senior management.

Agile added value: the structure of agile, where every single person would have a voice that everybody else should listen to, would help in achieving such consensus through transparent and effective communication through all over the organization/project. Such a structure would obtain not only the support but also the active involvement of all levels of employees.

- 3- After securing senior management support, risk management in charge should work with the risk sponsor to include risk management into the

strategic goals of the organization. The same should be conveyed across all departments, divisions, projects,...etc. This would add a sort of seriousness to risk management practices within the organization, and it will not be seen as another initiative.

Agile added value: the transparent nature of agile methodology (especially Scrum) and its team-oriented structure would obtain the buy-in from the different levels of employees.

- 4- Especially in the early phases of risk management implementation, risk management in charge should organize benefit realization sessions for the different departments at all levels to ensure that they understand the benefits of risk management and how significant it is.

Agile added value: Scrum as an agile methodology might present an added value through the different types of Scrum events: daily Scrum, Sprint review, and Sprint retrospective meetings. These events would enhance communication among the team and help them to reach a mutual understanding of the benefits of their works in risk management.

- 5- Once benefits are perceived, risk management in charge should work to integrate risk management practices within the daily routine of the employees and attach it to their core activities. This would help to avoid the idea of risk management as a time-consuming side task.

Agile added value: Scrum product backlog and Sprint backlog would help risk in charge of aligning risk management activities with employee daily routine. To achieve this, risk in charge shall ensure that he selected the right combination of team members and sprint backlog.

- 6- Risk management in charge should adapt to the sophistication level of risk management practices to match the anticipated role in risk management in the project / daily operation. Thus, it will not be seen as a complicated process.

Agile added value: the iterative nature of Scrum (the sprints) would help risk in charge and the nominated team to select risk management practices that suit the sophistication level of each Sprint. In such a way, risk in charge, along with the team, would ensure that the level of complication in

risk management practices matches its importance in each step of the project/ operation.

- 7- Risk governance should define roles and responsibilities in a clear and digestible way. This would represent a reference for the expectation of everyone and avoid any confusion about roles and levels of involvement. For the sake of formalization of risk management responsibilities, the same should be included in job descriptions.

Agile added value: agile would reduce the level of complication of risk management processes and pushes the team to focus on managing risks itself instead of limiting themselves to job descriptions, roles, and responsibilities. In agile, every voice should be heard, and every idea would be respected and discussed. Agile would encourage everyone to be part of risk management where he/she thinks that he/she can add value.

- 8- Risk management in charge should continue his/her efforts to improve the level of people's understanding and engagement in risk management to the level where everyone would realize that risk management is a tool to enhance their business performance as an ultimate target.

Agile added value: risk in charge can make use of the continuous interactions between the different stakeholders at all levels and the various Scrum events and discussions to ensure a better understanding and engagement of the different stakeholders from one iteration to the next.

### **2.6.2.3 Risk Management Standardized Practice**

Although modern risk management principles could be traced in literature back to the 1950s, if not earlier, risk analysis was the main point of concern, and it was for a longtime part of business management practices. Over the years and decades, practitioners and scholars recognized the importance of standardizing risk management practices, which has much more than only risk analysis. During the 1990's, multiple organizations and research entities put efforts to formalize project management practice and encapsulate it in internationally recognized standards. In

1996, PMI included a four-process risk management knowledge area into their Project Management Body of Knowledge (PMBok). In the same year, the British standard entity issued their standard no. BS 8444 for risk management (Merna & Al-Thani 2008). Risk management standardizing efforts continued over the last three decades and resulted in multiple standards and guides for risk management implementation on different levels. Such as ISO Guide 73, ISO 31000, Orange Book from HM Treasury, and many others (Hopkin 2017).

In their latest Project Management Body of Knowledge, the sixth edition, PMI has identified a seven-process risk management knowledge area which consists of the following processes (PMI 2017):

- 1- Plan Risk Management: it focuses on the mechanism of the risk management application in projects.
- 2- Identify Risks: it focuses on the process of identifying all possible risks, their sources, characteristics, and documenting the same.
- 3- Perform Qualitative Risk Analysis: it focuses on prioritizing the outcome of a risk identification process through a qualitative analysis for its probability and impact. Then, updating the documents accordingly.
- 4- Perform Quantitative Risk Analysis: it focuses on verifying and supporting the qualitative analysis results with numerical figures to offer the necessary support to the decision-making process.
- 5- Plan Risk Responses: it focuses on the process of evaluating the different options and strategies to respond to individual risks to select the most optimum course of action to be implemented to address the identified risks.
- 6- Implement Risk Responses: it focuses on executing the planned actions in response to the triggered risks.
- 7- Monitor Risks: the focus of this process is divided into multiple areas:
  - a. Monitoring the overall risk management process and assessing its effectiveness.
  - b. Monitoring the identified risks to ensure a proper response once a risk is triggered.

- c. Monitoring and controlling the execution of the planned risk response.
- d. Monitoring the residual risks and ensuring that such risks are adequately captured.

These processes are interconnected, where interdependencies will contribute in a more successful risk management. Each one of these processes could represent a Scrum cycle by itself, where the team would focus in each Scrum cycle to take the input of the previous Sprint or cycle and improve it in the coming Sprint /cycle. Figure 7 shows the flow chart of a standard risk management practice. Each of these processes has identified detailed inputs, tools, and outputs of each within PMI PMBoK or any other standard considered. Table 1 list the major tools and techniques suggested by literature to serve these processes.

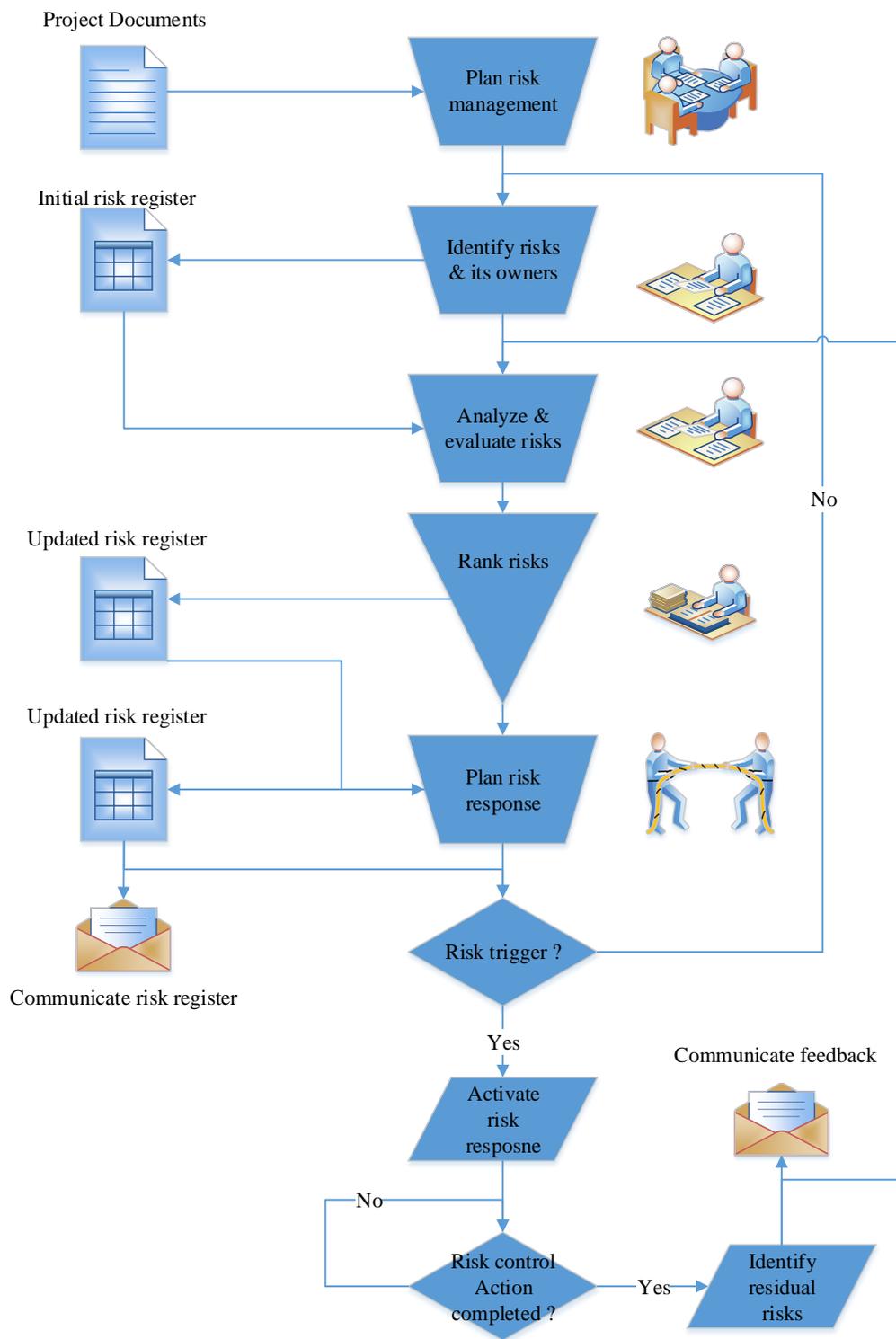


Figure 7 : Risk management flow chart

Table 1: Risk management tools and techniques (Gray, Larson & Desai 2013; PMI 2017; PMI 2009; Abdou, Lewis & Alzarooni 2004; Collier 2009; Merna & Al-Thani 2008; PMI 2013)

<b>Plan risk Management</b>	<b>Identify risk</b>	<b>Perform Qualitative risk analysis</b>	<b>Perform Quantitative risk analysis</b>	<b>Plan risk response</b>	<b>Implement risk responses</b>	<b>Monitor risks</b>
Data analysis	Documentation analysis	Probability & impact analysis	Sensitivity analysis	Brainstorming	Expert judgement	Risk reassessment
Expert judgement	Brainstorming	Data representation techniques	Expected monetary value analysis	Check lists	Project management information system	Risk audits
Meetings	Delphi technique	Data quality assessment	Monte Carlo simulation	Contingency planning		Variance and trend analysis
	Root cause analysis	Risk categorization	Decision tree	Decision tree		Technical performance measurement
	Check list analysis	Expert judgement	Expert judgement	Force field analysis		Reserve analysis

	Assumption analysis	Assessment of other risks parameters (urgency, controllability, detectability...etc.)	Data gathering	Alternative analysis		Meetings
	Cause and effect diagrams		Influence diagrams	Root cause analysis		
	Process flow chart			Continuous response strategy		
	Influence diagram			The risk premium		
	SWOT analysis			Expert judgement		
	Expert judgement			Cost-benefit analysis		
	Interviews					
	Prompt lists					

#### **2.6.2.4 Risk Management Benefits**

Risk management's importance exceeds the traditional management benefits of offering better control aspects over certain areas for the sake of performance improvement to be a significant guarantee for business continuity. Risk management is a valuable asset that would help whoever could use to hit his/her targets and own a superior decision-making mechanism. Hereunder few of the risk management benefits which are well addressed and documented in the risk management literature (Adapted from Merna & Al-Thani 2008):

- 1- It facilitated creating more realistic project management plans and set the expectations to a reasonable level.
- 2- It reduces the possible deviations from the agreed project plans and enhances the chances of adhering to it.
- 3- Provide a solid basis to drop projects which are unsound financially.
- 4- It offers a better basis to compare different alternatives.
- 5- It improves the ability of individuals to asses and identifies threats and opportunities that they face in their professional and personal life.
- 6- Encourage companies and individuals to take risks and obtain its benefits.
- 7- It supports decision-making mechanisms by offering a flexible format of data that could be used to make a decision.
- 8- It encourages individuals and teams to ensure the validity of their data to reduce possible risks they might face.
- 9- It increases confidence in making decisions.
- 10- It offers a useful database that could be used in a future project, and it would increase the chances of a successful implementation.
- 11- It increases clients' confidence in the organization and its individuals.
- 12- It offers a better approach to manage project contingencies.
- 13- It increases the chances of successful project management practices.
- 14- It helps organizations to avoid reputational risks.
- 15- It helps an organization to avoid or reduce the effect of what is so-called 'black swan event.'

### **3 A Proposed Agile Framework for Risk Management**

#### **3.1 Introduction**

In this chapter, a proposed agile framework for risk management would be explored. In the beginning, the need for such a framework would be discussed, followed by a proposed approach that would be discussed in detail. Starting with its artifact, followed by the proposed interpretation for Scrum concepts, tools, and techniques in the risk management environment.

#### **3.2 Risk Management vs Changing World**

Risk management has been described as a dynamic process that produces living documents since the early days of modern risk management in the mid of last century. In their latest PMBoK, PMI has heavily prompted the importance of considering how agile and adaptive our world is nowadays in all project management processes and knowledge areas (PMI 2009, PMI 2017).

For a long time, sound risk management practices have been linked to the availability of information, which increases continuously as project progress. This would promote the need for a re-evaluation of the identified risks and their mitigation plans. Additionally, an in-depth look at searching for new risks becomes a requirement and an essential step toward successful risk management. In their practice standard of risk management, PMI emphasizes the added value of revising the whole risk management processes and their output periodically to guarantee its effectiveness and promote the iterative nature of risk management. However, the rate and depth of such iterations and updates vary from a project to another based on the nature and circumstances of that project. Ultimately, risk management practice, as defined in the literature, could be described as an iterative and incremental process (PMI 2009; Hopkin 2017; Gray, Larson & Desai 2013).

Today's world is a complex combination of rapid changes, which, in most cases, cannot be predicted nor limited. Such circumstances would question the capability of traditional risk management practices to cope and the need for a more dynamic risk management approach. A thorough look into management literature, while the iterative and incremental nature of risk management in mind, would draw the attention toward agile management practices. Primarily, the solution of such problem is explicitly indicated in 'The Scrum Guide' written by Schwaber and Sutherland, the creators of Scrum, when they described Scrum as “[S]crum employs an iterative, incremental approach to optimize predictability and control risk” (2017, p.4).

Unlike other agile management methodologies, Scrum was distinguished with its focus on management techniques and processes (Cervone 2011; Hummel 2014; Khare & Shrivastava 2015; Tarwani & Chug 2016). Nevertheless, not every product can be produced through a Scrum cycle. Four factors were mentioned earlier to judge the suitability of agile approach for a specific project or product, which are: team, duration, criticality, and organization. Literature proposed that the best combination to maximize the benefits of agile methodology is: short duration, medium to low criticality, is subject to change, a small cross-functional and highly qualified team, a collocated actively involved customer, and a supportive organization. (McAvoy and Sammon 2005). Unfortunately, this is not always the case. Recently, there is a growing interest among researchers as well as practitioners to study possible scenarios where a mixed approach of agile and traditional management can be adopted. This aims to combine the benefits of both methodologies (Leybourne 2009; Silva et al. 2011). In this paper, we are going to explore the possibility of building an agile framework for the traditional risk management to form a hybrid risk management approach.

### **3.3 Risk Management: A Scrum Approach**

Successful risk management is a key to a successful project delivery, where each success in defining risk, planning its response, and successfully mitigated it, is a significant step toward the desired result. To accomplish this, risk should not be a

routine process that would be carried on based on a predefined cycle and implemented by a small group of people. Risk should be everybody's responsibility and every day's task (PMI 2009). According to the traditional risk management practices like the one defined by PMI, the frequency of risk management review cycles will be determined based on the project requirement. However, there is no rule of thumb to judge if such review cycles are good enough, and this is where Scrum will make a difference.

Looking into the benefits which were mentioned earlier, Agile management generally will enhance the knowledge sharing process among the project team and help them finding common ground to resolve the problem of interest. Also, it will improve the scope control mechanisms through short feedback cycles, which consequently will boost the final product quality. Thus, by employing Scrum or any other agile management methodology in risk management, we shall be anticipating (Solinski & Petersen 2014; Azanha et al. 2017):

- 1- A better risk management knowledge sharing within the project environment and facilitating the creation of a common risk understanding and language as well.
- 2- A better risk control mechanism through short transparent review cycles.
- 3- Boosting the chances of a complete hassle-free project through effective risk management.

Such benefits are expected to be obtained easily if risk management practitioners adopted the three pillars of Scrum: Transparency, Inspection, and Adaptation as transparency is expected to enhance the engagement of all project stakeholders in risk management activities and boost the risk culture of projects and organizations. Also, Inspection would help to avoid any misinterpretation of project circumstances and anticipated risks, which usually results in overlooking a few risks and magnifying others. Finally, adaptation would help the practitioner to tailor the project risk management methodologies to fit the nature of their projects and their circumstances (Schwaber & Sutherland 2017).

### 3.4 Scrum Risk Management Roles and Responsibilities:

Traditionally, project risk management was a task dedicated to specific team members without any special designations. However, Scrum is well-known for its team structure, along with unique titles that are used within the process, which represents one of the aspects that should be respected when using Scrum along with other management methodologies and techniques to improve the quality of the work. Accordingly, Table 2 shows the Scrum Risk Management proposed roles and responsibilities.

Table 2 Scrum Risk Management Proposed Role and Responsibilities

Role	Scrum Description	Scrum Risk Management Proposed Description
Product Owner	The individual who is responsible and accountable for managing the product backlog	The project manager could play this role and be responsible for maintaining the different documents and resources that will be investigated for anticipated risks.
Scrum Master	Scrum Master is in charge of supporting and promoting the Scrum process as it should be. Scrum Master's role is different from a traditional project manager where his/her primary role is not about controlling the ongoing works. Instead, Scrum master seeks to help everyone in Scrum team to understand his/her role and how to	Traditionally, there is no such role in risk management. However, there is a risk mentor role whose responsibility is to make sure that everyone within a project /an organization understands risks properly and could accurately deliver his risk related responsibilities. Ultimately, his role is similar to Scrum Master's in concept. Thus, we might propose that

	interact with other team members	risk mentor should be trained on the role and responsibilities of a Scrum Master and handle both roles: to be a Scrum Master and a risk mentor and carry the full responsibility for proper implementation of Scrum Risk Management.
Development Team	The development team is a self-organizing, structured, empowered, and cross-functional team, where there is no title, no sub-team, and accountability belong to the team as a whole. The optimum size of the development team is 3-9 members. This count does not include the roles of the Scrum Master and product owner	In Scrum risk management, the team is proposed to be the project team themselves, where every team member will participate in a risk management process that is related to his expertise. Thus, the team here is proposed to be a dynamic team that would be changed after every sprint to allow the risk management process to gain the benefit of different expertise within the team.

### 3.5 Scrum Risk Management Events:

Literature used to highlight the iterative nature of risk management, emphasizing the need to reevaluate identified risks, their mitigation plans, and their triggers. However, without any standard rule of thumb to control how often these reviews should happen. It was always left to the judgment and sense of the project manager and his team (PMI 2009; Hopkin 2017; Gray, Larson & Desai 2013). Employing

Scrum to do risk management would improve this aspect by utilizing the Scrum event to control the iterative and incremental nature of risk management, where the updated risk register could be considered as the resulting release of each cycle. In table 3, Scrum event and the correspondent Scrum risk management events are listed.

Table 3 Scrum Risk Management Events

Event	Scrum Description	Scrum Risk Management Proposed Description
Sprint	It is the base stone of Scrum. A time-limited process might vary from a week as a minimum to one month as a maximum. During the Sprint, an agreed portion of the product backlog would be considered as a scope of this Sprint. However, once accepted and Sprint is initiated, its goals are fixed and none negotiable.	In Scrum risk management, Sprint is proposed to be a time-boxed review cycle for any aspect of risk management according to the structure of the framework that would be discussed later on. Its scope would be to conduct Scrum risk management with regards to defined the whole project at the initial stage, then portions of it during the review cycles.
Sprint Planning	A limited-time meeting with a maximum of 8 hours for a one-month Sprint in which the team would discuss the goals of the upcoming Sprint and how to achieve it.	In Scrum risk management, Sprint planning workshop would respect the definition of Sprint planning in Scrum, and the only difference would be the scope of Sprint, which, here, would be related to risk management.
Daily Scrum	A 15-minute limited-time daily meeting. The only	In Scrum risk management, Scrum, the meeting would

	<p>development team is essential to participate. Scrum where they discuss what they achieved in the past 24 hours, what they are planning to accomplish during the coming 24 hours, and any impediment or showstopper that they perceived it would prevent them from delivering the Sprint goal.</p>	<p>have the same purpose, where the team would discuss what they have done in the past 24 hours with regards to risk management, what they are planning today in the coming 24 hours, and highlighting any showstopper. However, the most essential and interesting output of such a meeting is to identify any trigger events that were identified during the last 24 hours. This would help to maintain a proper monitoring process for risks' triggers and avoid the possibility of overlooking these triggers as much as possible.</p>
Sprint Review	<p>A limited-time meeting with a maximum of 4 hours for a one-month Sprints, which aims to discuss the outcome of the Sprint with the imperative stakeholders. In such a meeting, development team will present their works, discuss it with the audience, and answer their questions.</p>	<p>In Scrum risk management, this meeting would aim to discuss the outcome of the Sprint and the effectiveness of the ongoing risk management practices and process. In such meetings, the team would consult with the concerned stakeholder the risk register updates, risk mitigation plans, risk fundamental measure like</p>

		<p>risk tolerance, and risk appetite. Such a meeting would provide the team with directions for the next Sprints and highlight the critical challenges.</p>
<p>Sprint Retrospective</p>	<p>A limited-time meeting with a maximum of 3 hours for a one-month Sprint. During which, the team would discuss their and their processes performance. Furthermore, potential improvement and corrective actions would be planned during this meeting.</p>	<p>In Scrum risk management, this meeting would maintain its core concept, which would be tailored to fit the risk management process. In such a meeting, the team would evaluate their performance in the lights of their Sprint output and the Sprint review outcomes. This meeting would highlight the team and process strengths and weaknesses. The team would have a chance to pinpoint any risk-related issues which were overlooked or mistreated and propose the anticipated improvement to project risk management process and team skills.</p>

### 3.6 Scrum Risk Management Artifacts:

Scrum founders introduced few artifacts that would complete the full picture of Scrum methodology and help practitioners to implement it properly. Using Scrum for risk management applications would not eliminate the need for such artifacts. Instead, it would require these artifacts to be adapted to fit the purpose. Table 4 introduces Scrum artifacts in the risk management context.

Table 4 Scrum Risk Management Artifacts

Artifact	Scrum Description	Scrum Risk Management Proposed Description
Product backlog	A dynamic document that would cover all the features and functions which are aimed to be in the final product, along with its attributes.	In the risk identification phase, it would be a dynamic document that would cover the overall project scope, which risk management processes are intended to handle. This document shall describe the work packages and its sub-packages along with the defined risk appetite and tolerance for each of them, cost, resources, dependencies, stakeholders, ...etc. During the implementation of the project, the product owner would ensure to remove the items related to the completed scope and add any additional scope/items that might be added to the project

		<p>scope through a proper change management process. Then, in the risk analysis phase, the product backlog would be rearranged around the risk register resultant from the risk identification phase. In the risk response planning phase, the product backlog would be updated with risk register resultant from the risk analysis phase. Finally, risk monitoring and controlling phase product backlog is the updated project risk register with the associated performance and work-related information.</p>
Sprint backlog	<p>It is a subset of selected product backlog items that are planned to be executed in a Sprint, along with the aimed increment delivery plan.</p>	<p>It is a subset of the project scope. It might be a complete work package, a portion of a work package, or even multiple work package as it would be agreed among the team during the Sprint planning meeting.</p>

## Agile Management Techniques Applications in Scrum Risk Management

Agile management has a vast number of tools and techniques listed under different agile management methodologies. Previously, a few techniques were discussed. In table 5, the applications of such techniques in Scrum risk management are pondered.

Table 5 Agile Management Techniques Applications in Scrum Risk Management

Technique	Agile Description	Scrum Risk Management Proposed Description
Pair Programming	This technique is based on the idea of a 'second pair of eyes', where two programmers will be working together to produce a single piece of code. The code would be written by one of the programmers, while the other will be checking the synthesis of the written code with the other pieces of code which were written previously. This would represent a continuous auditing for the code under production.	To have two team members working on the same task (identifications, evaluation, monitoring, etc.). One member will be focused on the task itself, while the other member will look into the relationship between his colleague's outcome and the previous information available. The purpose of this proposal is to help the team to track the relationship among the different risks and their parameters.
Ubiquitous Language	It is a shared terminology between the product producers and the product users, which facilitate the proper and successful implementation of the product in the shortest time possible.	It would be of great help to have a common risk language between the project team and other stakeholders. Ultimately, this would increase the effectiveness of risk management within the project.

Active Client Involvement	Agile methodologies consider the active involvement of the client as a cornerstone for the success of the whole process. According to agile literature, this would help to get the client feedback as quickly as possible and avoid abortive works.	Active involvement of the client in risk management would bring considerable advantages to the whole process and increase the project team's capabilities to manage the project risks efficiently. However, this would require a client who is risk-educated and willing to consider being part of the risk management process. On the other hand, if the client is risk-educated or not a risk-taker, this would represent a massive risk by itself.
Informative Workspace – Information Radiators	To use all the possible attractive media to keep the project team informed and aware of the project status. Whiteboard, Screens, Kanban boards, burnup charts, burndown charts, ...etc., are examples of possible means for information sharing.	Sharing information and utilizing information radiators would help the project team to be actively involved in risk management and aware of the risks that he/she might face during the project lifetime. This would enhance the team's resilience to risks and improve their capabilities to manage it successfully. However, whoever will be responsible for sharing such information, shall be selective and well educated to avoid sharing

		information with the wrong audience.
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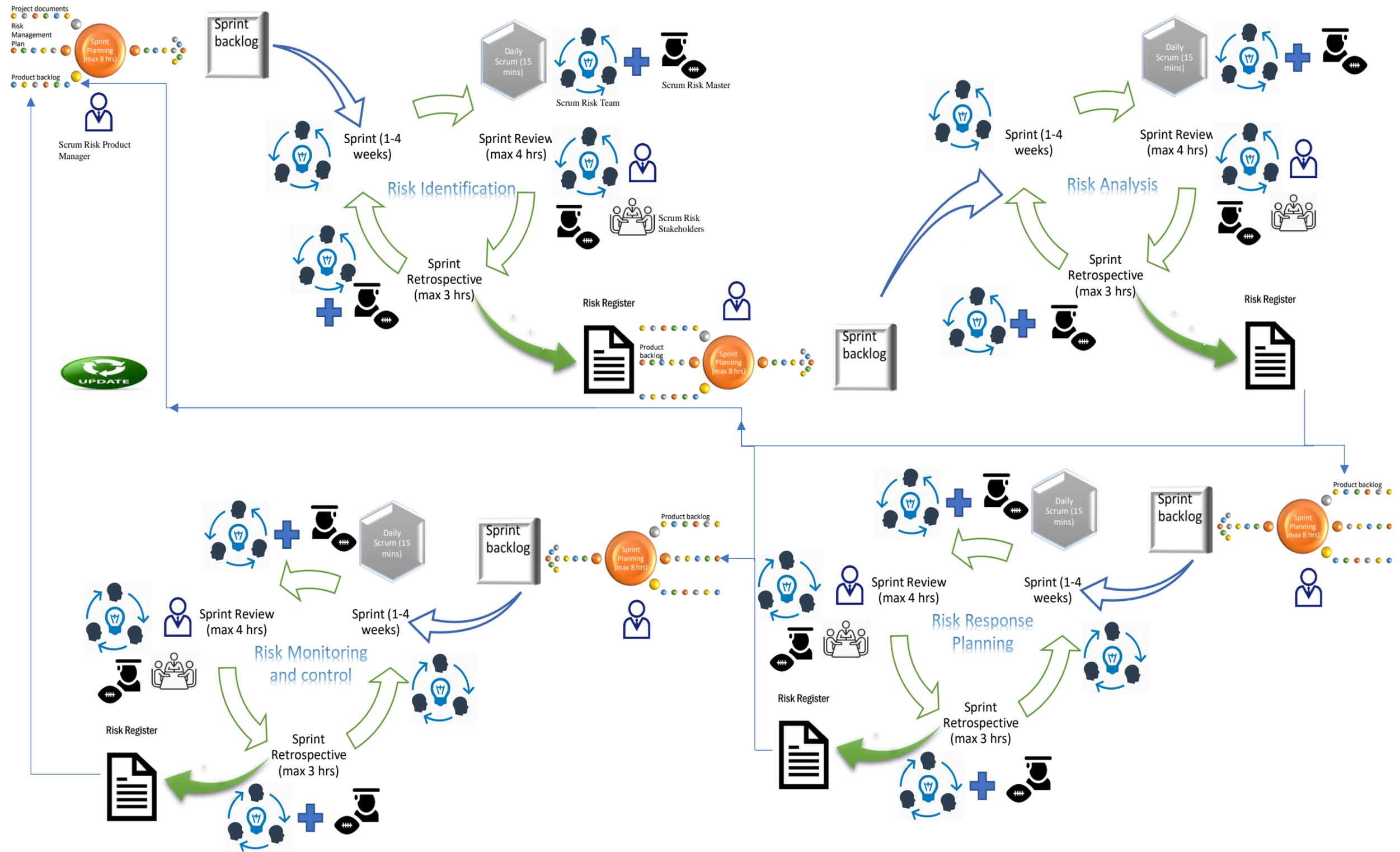


Figure 8 Scrum Risk Management Proposed Framework (*Infographics* copy rights belongs to their creators)

## 4 A Typical Scrum Risk Management Work Flow

### 4.1 Introduction

As explained in figure 8, Scrum risk management consists of 4 Scrum cycles for risk identifications, analysis, risk response planning, and risk monitoring and control, in order. These 4 Scrum cycles would follow the traditional process of creating a risk management plan, which by itself represents an input to the first Scrum cycle. Once the risk management plan process is complete, the Scrum risk management cycle would be initiated. In the following section, a simple typical Scrum risk management cycle would be proposed.

### 4.2 Scrum Risk Identification:

Once a risk management plan is in place, Scrum risk identification will be initiated. As a Scrum process, the first step would be to define your Scrum risk team members, your Scrum risk events, and the corresponding Scrum risk artifacts.

Table 6 Scrum Risk Identifications Definitions

Scrum Risk Element	Scrum Risk Identification Description
Product Owner	The project manager will be responsible for this role where he/she would be responsible for making the best use of the risk management practices implemented by the project team, and he/she would hold the ultimate accountability for managing the product backlog. He/she shall ensure that the product backlog is crystal clear to Scrum risk team.
Product backlog	Product backlog would be a document that has the project baselines (cost, time, and resources), stakeholders management information, procurement management information, quality management information, an initial risks list, and a risk

	<p>management plan. All this information shall be combined together and itemized according to work packages or even sub-packages in case of large projects.</p>
<p>Scrum Risk Master</p>	<p>Scrum risk master is the servant leader for the whole process. He/she would help the product owner to gain effective techniques to manage the product backlog and ensure a clear and digestible product backlog. With the development team, Scrum risk master shall coach the team through all their Scrum events making sure that Scrum is fully understood and implemented, shall coach the team through risk identification activities, and removing obstructions to their progress toward effective and efficient risk identification activities.</p>
<p>Sprint Planning Meeting and Sprint Backlog</p>	<p>Sprint planning is a time-boxed meeting with a maximum duration of 8 hours. In this meeting, the Scrum risk team would discuss the scope to be covered under the coming Sprint. In this meeting, the team would select a work package. Work packages or work sub-packages which they plan to do risk identification for. Once this is done, the team would discuss and choose the tools and techniques that are planning to use to perform the risk identification activities in the coming sprint. It is only up to the risk development team to define the scope they are going to carry ahead and how they are going to perform risk identification activity. Scrum risk Master would provide them with the necessary guidance without dictating to them what to do. Finally, the team would set the Sprint goal.</p> <p>Sprint backlog would be divided into three categories:</p> <ol style="list-style-type: none"> <li>1- For the very first sprint, sprint backlog would be the whole product backlog with a goal of addressing and identifying the major risks which the project might face.</li> <li>2- For the following sprints, its backlog would be a work package or sub-package according to the project size where the target would be to have a thorough inspection</li> </ol>

	<p>of every aspect of the backlog and identify all anticipated risks. Input at this stage would be the product backlog, the latest updated risk register and other risk documentation, the expected capacity of the risk development team and their past performance Key Performance Index's (KPI's).</p> <p>3- Once the risk identification process is complete for all work packages, review and update cycles would take place to ensure that all risks, even the ones which would rise; as a result to project progress and its dependencies, are well captured.</p>
Sprint Duration	<p>Sprint duration would vary from a single week up to a month. Risk development team would define the sprint duration during Sprint planning meeting.</p>
Risk Development Team	<p>Risk development team shall be a dynamic team whose members are changing in every sprint to ensure that every single project team member participated in risk identification activities. Here are a few recommendations for the structure of the team in the different phases of the process:</p> <ol style="list-style-type: none"> <li>1- For the very early sprint, it is recommended to include the technical expert of each work package to facilitate achieving its target, as mentioned earlier.</li> <li>2- For the following sprint, the team is recommended to be built from an individual who has experience in the specific work package under study.</li> <li>3- For review and update sprint, it is recommended to keep the team formed around the work package. But, try to include new team members as applicable to ensure that the risk identification process obtained the maximum benefit of every individual's experience.</li> </ol>
Daily Scrum	<p>A time-boxed stand-up meeting of a 15-minute duration where risk development team members would discuss what risks they</p>

	<p>have identified yesterday and which part of the sprint backlog they were working on, which part of the sprint backlog they are planning to work on today and any obstacles they are facing. Also, team members would highlight if they identified a significant risk that could be a showstopper. This could be discussed in a separate meeting.</p>
<p>Sprint Review Meeting</p>	<p>A time-boxed meeting with a maximum duration of 4 hours. It is a product owner's responsibility to call for this meeting. However, Scrum risk master shall ensure that such a meeting takes place according to Scrum guidelines and that attendees understand its purpose. During this meeting. This meeting shall be attended by a product owner, Scrum risk master, risk development team, and selected stakeholders where they shall discuss the identified risks, risk identification basis which were used, and collaborate on what to do next.</p>
<p>Sprint Retrospective Meeting</p>	<p>A time-boxed meeting with a maximum duration of 3 hours. Scrum risk master shall ensure that such a meeting takes place on time, and it is attended by all risk development teams. During this meeting, the team would discuss their performance in the completed sprint, criticize themselves positively and constructively and propose potential improvements.</p>

### 4.3 Scrum Risk Analysis:

Once the first risk identification sprint is completed, and an initial/updated risk register is issued, Scrum risk analysis will be initiated. Scrum risk analysis activities shall cover qualitative risk analysis, quantitative risk analysis, and risk ranking activities. Although Scrum risk analysis is a separate Scrum cycle from the others, its product backlog, and its increment is directly connected to the other Scrum cycles. Furthermore, Scrum risk team shall ensure proper synchronization among the different Scrum cycles.

Table 7 Scrum Risk Analysis Definitions

Scrum Risk Element	Scrum Risk Analysis Description
Product Owner	The project manager will be responsible for this role where he/she would be responsible for reformatting the risk register resultant from the Scrum risk identification cycle to a product backlog and transfer to the Scrum risk analysis cycle smoothly. He/she shall ensure that the product backlog is crystal clear to Scrum risk analysis team.
Product backlog	In this phase, the product backlog of the identification phase will be updated with the risk register resulting from Scrum risk identification cycle in addition to any update for the other project related information and restructured around the captured risks.
Scrum Risk Master	Scrum risk master shall work with the product owner to ensure a smooth transition between the different Scrum cycle. During this transition, Scrum risk master shall guide the product owner through the transformation process of the product backlog and ensure that the new backlog is complete and digestible to the team. Moreover, Scrum risk master shall guide the team to a proper Scrum practice and provide them with the needed advice to complete a successful risk analysis process.
Sprint Planning Meeting and Sprint Backlog	Similar to the Sprint planning meeting in the identification phase, Scrum risk analysis sprint planning would host discussions about the product backlog items to be considered for the coming sprint and the tools, techniques, and methods that would be adopted to perform the qualitative and quantitative

	<p>analysis and ranking activities. Then, set the objective of the sprint. To maintain the synthesis of the overall risk management process, it would be recommended to align the Scrum risk analysis sprint backlog with the latest sprint backlog of risk identification Scrum cycle.</p>
Risk Development Team	<p>Risk development team structure and management process are similar to these described under the Scrum risk identification cycle. However, it would be recommended to choose a multi-functional team that could cover the different aspects of the project: cost, schedule, scope, and quality. This would help to warrant that all these aspects would be appropriately addressed through risk analysis activities.</p>
Daily Scrum	<p>A time-boxed stand-up meeting of a 15-minute duration where risk development team members would discuss the level of analysis, they completed the day before, for which backlog item, what their target for the same day is. Also, team members would mention any impediment to complete their analysis activities. This could be discussed in a separate meeting.</p>
Sprint Review Meeting	<p>Sprint review meeting for Scrum risk analysis cycle is similar to these organized for Scrum risk identification with regards to its time, duration, organizer, facilitator, and general agenda. However, it would be different in the details of that agenda. In this meeting, the attendees would discuss the results of the qualitative and quantitative analysis of the risk identification and the basis which were used to reach out to these results. Furthermore, they would discuss the results of risk ranking and its basis. Then, they would team up on what to do next.</p>
Sprint Retrospective Meeting	<p>Sprint retrospective meetings would continue to be the internal audit event of a sprint with a similar audience, facilitator, agenda, ...etc. to that one described in Scrum risk identification phase.</p>

#### 4.4 Scrum Risk Response Planning:

Following a successful Scrum risk analysis sprint, a Scrum risk response planning cycle will be initiated. Scrum risk response planning activities would be directed by the preferred strategies of the Scrum risk team or the organization itself toward positive and negative risks.

Table 8 Scrum Risk Response Planning Definitions

Scrum Risk Element	Scrum Risk Response Planning Description
Product Owner	The project manager will be in charge of this role where he/she would be responsible for combine the updated ranked risk register resulting from the latest Scrum risk analysis sprint with the risk management plan and form a solid product backlog. He/she shall ensure that the product backlog is crystal clear to Scrum risk team. A product owner would ultimately be accountable for a smooth transition between the different phases with support and guidance from the Scrum risk master.
Product backlog	The backlog of this cycle would be a combination of the updated ranked risk register resulting from the latest Scrum risk analysis sprint with the updated risk management plan itemized in a practical way, which would allow the possibility to select one or more for each Sprint.
Scrum Risk Master	Scrum risk master shall continue to offer his support to the product owner and risk development team to ensure proper Scrum implementation for risk response planning activities. Also, he/she is expected to extend the professional advice to the risk development team about risk response planning tools and techniques.
Sprint Planning Meeting and	Similar to Sprint planning meeting of Scrum risk analysis Sprint this meeting would host discussions about the product backlog items to be considered for the coming sprint and the tools,

Sprint Backlog	techniques, methods, and recommended strategies that would be adopted to plan for risk responses. Then, set the objective of the Sprint. Maintaining a proper alignment for product backlog of the different cycles is highly recommended.
Risk Development Team	Risk development team structure and management process would continue to be similar to these described in the Scrum risk analysis cycle. Nevertheless, the selection of the team members shall respect the type of expertise required at this stage.
Daily Scrum	Daily Scrum stand up meeting at this stage would maintain its standard features. The Scrum risk master shall ensure that this meeting is taking place regularly, and its purpose is fully understood and properly utilized by the team.
Sprint Review Meeting	With similar features and parameters to sprint review meetings in other cycles, the attendees would discuss the planned response of the identified risk, the strategies behind such responses, and its anticipated outcomes. Then, they would team up on what to do next.
Sprint Retrospective Meeting	Sprint retrospective meeting is crucial at this stage as it would help the team to adjust their planning strategies in the light of the stakeholder feedback during the sprint review meetings.

#### **4.5 Scrum Risk Monitoring and Control:**

Unlike other Scrum risk cycles which do not would be initially completed during the project planning phase, then continues all over the project span, Scrum risk monitoring, and control cycle would be initiated only once the outputs of project monitoring and control process are available as it forms an essential portion of the product backlog of this cycle. Furthermore, the increment resultant from this cycle would be directly integrated with the change management process.

Table 9 Scrum Risk Monitoring and Control Definitions

Scrum Risk Element	Scrum Risk Monitoring and Control Description
Product Owner	Similar to the other cycle, the project manager would be the preferred player for the role of the product owner. Being the ultimate owner of the project monitoring and control measure would help the project manager to attend the role of the product owner successfully. A product owner would continue to carry his responsibilities to ensure the clarity of the product backlog and a smooth transition between the different phases with support and guidance from the Scrum risk master.
Product backlog	The backlog of this cycle would be a combination of the latest updated risk register resulting from the newest Scrum risk response planning Sprint with the updated risk management plan and the work performance information and reports generated by the project monitoring and control processes.
Scrum Risk Master	Additionally to his/her essential role of mentoring the team for whatever related to Scrum risk management processes, Scrum risk master has to ensure that development team has the necessary tools and skills to analyze the work performance information and reports efficiently to avoid overlooking any vital information that would help to prevent threats and enhance opportunities.
Sprint Planning Meeting and Sprint Backlog	Unlike other sprint planning meeting, in this cycle the team would not discuss which items from the product backlog shall be addressed in the coming sprint, as it would be highly recommended and required to keep all the backlog items in the sprint backlog as the team cannot afford to miss any piece of information that would help them to manage risks properly regardless how big or small they are. Nevertheless, the team might decide to pay more attention to the risks that they think

	might be triggered at this stage of the project. The tools and techniques that would be used in the coming sprint would be discussed as well. Then, Sprint goal would be set.
Risk Development Team	Risk development team structure and management process would be maintained similar to these applied in the other cycles. Yet, the selection of the team members shall cover all required expertise to ensure proper monitoring and control for all types and categories of risks.
Daily Scrum	Daily Scrum meeting at this stage is more critical than in any other cycle where the continuous exchange of information among the development team and the timely notification for any obstacles or updates are crucial for the success of the process.
Sprint Review Meeting	With similar features and parameters to sprint review meetings in other cycles, the attendees would discuss the triggered risks, their status, any additional risk information, the status of invoked and none invoked contingencies, and the resulting updates for the risk register and other project documents. Then, they would collaborate on what to do next.
Sprint Retrospective Meeting	Sprint retrospective meetings would help the team to improve their performance based on the outcomes of the sprint review meeting, identify their shortfalls, and address it adequately.

## **5 Research Design and Methodology**

### **5.1 Introduction**

Literature defines research as a systematic approach to reach suggestions and conclusions in an area of concern that is conveyed and communicated to interested communities and individuals (Saunders, Thornhill & Lewis 2009; McLeod 1994). Research has to be built based on a clear design that defines the philosophical standing of the researcher (Easterby-Smith, Thrope & Lowe 2002). This research aims to explore professional and scholars' perspectives about utilizing agile methodology – Scrum specifically – to run risk management activities and how this could affect the efficiency of risk management. Seeking the optimization of the research process, the first step has to develop a proper research design. This chapter offers a systematic review of the theoretical concepts of research philosophy, methodology, and methods. Such a study would facilitate the justification of the adopted research philosophy, methodology, and techniques.

### **5.2 Philosophy of Knowledge**

Scholars might have different perceptions on the representation of knowledge, its value, nature, and accordingly how to obtain a piece of knowledge in an area of concern and interpreted to a form that is understood by others (Saunders, Thornhill & Lewis 2009; Creswell 2009; Bryman & Bell 2011). In the following section, three philosophies of knowledge would be explored before proceeding with research design:

#### **5.2.1 Epistemology**

As defined by Flick, epistemology is “[T]heories of knowledge and perception in science” (2014, p.536).

Similarly, Bryman and Bell (2011) claimed that epistemology refers to how knowledge is perceived to be acceptable or not. Similarly, Taylor and his co-authors argued that the credibility level of knowledge could be evaluated if knowledge is constructed by assumptions (2009). Epistemology indicates that a serious engagement with the topic of concern and the capacity to utilize data to achieve the consensus is required for information to be well-thought-out as knowledge (Bryman and Bell 2011). Consequently, the value that epistemology represents in any research is how knowledge creation can be structured to allow for various methodological approaches integration with a possibility to accommodating numerous epistemological positions that could be chosen by a researcher (Smith 1983).

### **5.2.2 Ontology**

The concept of ontology focuses on the researcher's perception of the nature of knowledge within specific social entities and the nature of its existence (Bryman 2012). An Individual's perception of the existence of certain phenomena and the nature of this existence would have a serious impact on how knowledge creation and/or the nature of its process structure would be perceived (Crotty 1998, Healy & Perry 2000). This could be easily seen in the design of their own research process, where they would select processes according to whatever ontological stands they adopted (Saunders, Thornhill & Lewis 2009). This is a crucial concept for this work where it emphasizes the importance of understanding the nature of risk management, its processes, and the structure of agile management methodology to build up the aimed framework.

### **5.2.3 Axiology**

Exploring the relationship between the researcher him/herself and their works, Saunders, Thornhill, and Lewis (2009) argued that our values as researchers influence how we conduct our research works. Values like ethics, personal values,

...etc. would have an influence on how we make decisions during our research works and how collected information and research results could be interpreted (Somekh & Lewin 2005). Axiology is that philosophy which aims to assess this relationship (Smith & Thomas 1998). Axiology is vital to this research, where it would help to ensure the transparency of results reporting irrespective of the researcher's values and thoughts.

### **5.3 Research Paradigms**

The importance of defining the chosen research paradigm in the initial stage of research refers to its direct and indirect impact on researcher's decisions about research design, the selected data collection method and the data analysis methodology that would be used in a later stage of research (Easterby-Smith, Thrope & Lowe 2002). This indicates that the principle reasoning which can be adopted by researchers is driven by their perceptions and beliefs about the relationship between knowledge and research and how both work together to satisfy human curiosity and hunger to know (Saunders, Thornhill & Lewis 2009). Exploring the feasible research paradigms toward selecting what research thinks it would serve his work helps to save the tangible and intangible resources of research and allows researchers to focus their efforts on more productive approaches (Easterby-Smith, Thrope & Lowe 2002; Bryman and Bell 2011). For this work, four research paradigms will be explored: positivism, empiricism, realism, and interpretivism.

#### **5.3.1 Positivism:**

Positivism usually adopted by researchers who believe in what is called natural science (Bryant 1985; May 2011). This implies that without an indication that can be utilized to conduct experiments that evidence any causality, most likely, such works would be considered irrelevant (May 2011). Bryman and Bell (2011) argued that positivism is based on an epistemological stand that promotes the important

role of natural science whenever social reality is under study where it facilitates a thorough probing of a matter of concern, which ultimately leads to dig up the aimed facts. Positivism dictates to researchers to detach their perceptions, understanding, and feeling from the subject under study to eliminate any unintentional bias that research might have during his work to investigate, explore, test or foresee the prospective behavior to ultimately explain all the issues surrounding the concerned phenomenon (May 2011). The importance of this paradigm to the works carried by this paper is the need to analyze and describe all the issues that surround risk management and agile management methodology. However, this would not cover the whole scope of the research where it would depend on subjective data to judge the feasibility of using agile methods to run risk management activity and to evaluate its impact on the efficiency of risk management itself. This implies a shortage of positivism capabilities to be adopted as a single research paradigm.

### **5.3.2 Empiricism:**

Depending on real experience to obtain the aimed knowledge is the research basis for a researcher who adopts empiricism. This comes from the fact that empiricism values the tangible outcomes of an experience which can be attained neither by relying on social science nor on cross-examining literature (Bryman and Bell 2011). According to Frege (2005), empiricism dictates that knowledge would be generated from data that is empirical in nature and could be processed and analyzed, originating the tangible evidence out of which knowledge is obtained. This implies that in empiricism, data is collected to ultimately form the theory, which is not the case with positivism where theories are presumed. Then, data is collected to prove or deny the theory (May 2011; Bulmer 1982). However, in either of these paradigms, researchers have to detach themselves from the social community under study and ensure that all collected data are entirely independent and not biased to their personal stands (May 2011). Empiricism tends to utilize experiments to collect data, which results have to be reported bluntly without fashion (Gilbert & Mulkey 1984; Marsden 1982). Eventually, empiricism removes all forms of ostentation and shallow elements and focuses on substances that are

feasible to reason with (Bhaskar 1989; May 2011). This work is established to examine the feasibility of using an agile framework for risk management application, which is established after reviewing the literature of both fields, i.e., a theory is set before collecting the data. Accordingly, empiricism is thought of as an appropriate paradigm for such research.

### **5.3.3 Realism**

Realism as a paradigm of research promotes the concept of a social realist as a fundamental and primary characteristic of a researcher who would be able to analyze the issue according to his knowledge to obtain a realistic view of that issue (Saunders, Thornhill & Lewis 2009). This emphasizes the concept that the researcher's behavior and their technique on how to deal with a social problem are related to their knowledge (Bhaskar 1993). In Realism, researchers are encouraged to utilize their consciousness to judge the issue of concern, which opposes the approach of positivism and empiricism, where researchers have to isolate their thoughts, beliefs, and perceptions before judging the matter of concern (May 2011). However, the researcher has to show proper qualifications and knowledge in their area of interest to qualify himself to use the realism paradigm of research. Consequently, to consider the realism paradigm for this research, specialization and vast and in-depth knowledge of agile project management and risk management is required. As a result, realism is not recommended for this type of research where a researcher is trying to form a new framework and build a unique experience of agile risk management.

### **5.3.4 Interpretivism**

Interpretivism is a paradigm that promotes the interaction between a qualified researcher and human subject to build the aimed knowledge, where both of them can influence the collected data and, ultimately, the resulted outcome (Bryman & Bell 2011). In this paradigm, it is a researcher's responsibility to drive the process of data collection toward the targeted set of data while asking the right questions to subject humans or recording proper observations (Grint 2000). Then, eventually, how to analyze and manipulate the data and investigate and resolve the relations

among the social units of the society (May 2011). Bryman and Bell (2011) argued that the core advantage of interpretivism is the fact that it encourages researchers to investigate literature and collect the aimed data either qualitatively, quantitatively, or using both approaches, so ultimately, data can be analyzed transparently. Consequently, interpretivism offers the essential tools required for research to compile deeper meanings from subject humans without any restriction to a form of data.

### **5.3.5 Justification for Selecting Research Paradigm: Positivism and Interpretivism**

This work is divided into two parts: gathering the necessary data from the literature to build the aimed framework, then measure selected audience enthusiasm about this new framework and their support to its concept. Considering these two parts, it could be argued that positivism and interpretivism are the best fit for such work. This can be justifiable by the need for objectivity in building the theory of the work that is offered by positivism, which would most likely lead to quantitative data. This would leave the work halfway through with data, which needs to be interpreted with human subjectivity to ravel the various subject human stands from the framework of concern and its influence on risk management process.

### **5.4 Research Process: Reasoning Approach**

Saunders, Thornhill and Lewis (2009) suggested that there is a direct relation between the research choice if reasoning approach and the adopted research approach itself. This concept was also supported by Bryman and Bell (2011) where they argued that for the same piece of work, reasoning method would be different when there is a theory in place before gathering the data from the one that would be used when the theory would be built based on the gathered data.

#### **5.4.1 Inductive Theory of Reasoning**

The inductive theory promotes the concept that a researcher, once he defines his research aims, to kick an observation process for an area of concern, collecting data out of their observation from and utilize these data to build up a theory to explain their observations (Bryman & Bell 2011). As argued by Saunders, Thornhill and Lewis (2009), the inductive approach is not efficient for all types of research. Taking into consideration that the aim of this research is to develop a new agile framework to run risk management application, which makes it challenging to build it out of observation, it would be suitable to argue that the inductive theory of reasoning is not the best vehicle to deliver such research.

#### **5.4.2 Deductive Theory of Reasoning**

Unlike inductive reasoning, deductive theory development does not consider observations as a vehicle to reach out to theory. Instead, the deductive approach of reasoning dictates that a researcher shall commence with a proposed theory or hypothesis, followed by a set of observations of the matter of concern, based on which definite conclusions can be obtained to confirm or deny the proposed theory or hypothesis (Bryman & Bell 2011; Saunders, Thornhill & Lewis 2009). Having this in mind, it would be reasonable to claim that deductive theory reasoning is a logical, rational choice for this work to adopt as it would allow for the creation of the aimed framework, then judging the same using the data collecting through the observation process which would enable the researcher to confirm or deny the feasibility of the proposed framework.

As a result, it could be argued that the selection of either inductive or deductive theory reasoning process is a subjective process and depends on the perception of the researcher for the best vehicle to deliver his work. Ultimately, there is no rule of thumb to be dictated for such a process (Bryman & Bell 2011). For this work, it

is of a sense to adopt deductive theory reasoning considering the nature of this research.

## **5.5 Research Methodology**

The general design approach of research work is known in the literature as a research methodology (Bryman 2012), where the selected method indicates the principal approach for research implementation considering the nominated knowledge philosophy, the appropriate research paradigm (positivism and interpretivism) and a suitable reasoning theory (deductive). No matter what name a research strategy is given, literature defined three basic research strategies that represent the base of every research, which are: qualitative, quantitative, and a mixed approach where techniques from both qualitative and quantitative would be used together based on research requirements (Bryman 2012).

### **5.5.1 Qualitative Research Methodology:**

Silverman (2014) suggested that a research methodology could be described as qualitative when it depends heavily on signs, words, and symbols, which are not merely representable by numbers; such type of data is known in the literature as qualitative data. Furthermore, qualitative research data is captured using techniques that might include contextualization of research works to facilitate social interaction (May 2011). Such an approach is suitable for the interpretivism research paradigm, where research can examine the social world in many ways and express their ideas and thoughts in various ways instead of depending on numbers only to describe it (Bryman & Bell 2011). The whole decision whether or not a qualitative approach is feasible for a piece of research is dictated by the type of data that would be processed to reach out to the research results, where qualitative – none numerical – data is the main motive to adapt qualitative approach. However, in some instances – like the Likert scale, categorical data is represented using numerical values, and it would still be considered as a proper input for qualitative research works (Brase & Brase 2011).

### **5.5.2 Quantitative Research Methodology:**

Following quantitative research methodology dictates to a researcher to concentrate on collecting numerical data that could be studied and analyzed to formalize the obtained output of such research work (Bryman & Bell 2011). To achieve this, the researcher has to design his data collection mechanism to focus on quantitative data (Saunders, Thornhill & Lewis 2009). This includes setting up experiments, counting mechanisms, etc. As suggested by Bryman and Bell (2011), qualitative data like texts and notes can be utilized to collect numerical data.

### **5.5.3 Mixed Research Methodology:**

In specific research works, the researcher is required to obtain qualitative data to perform descriptive analysis. At the same time, he would be required to collect quantitative data to provide a comprehensive interpretation of the data. In such a situation, a mixed research methodology shall be adopted (May 2011). The research could utilize qualitative methods to gather information from literature, surveys, documentation, and interviews to attain what is beyond the data (Bryman & Bell 2011). While quantitative methods could be employed to test and verify hypotheses (May 2011).

### **5.5.4 Justification for Employing Mixed Research Methodology:**

In this research, a mixed methodology was utilized to build the study and achieve its aims. As defined by Johnson, Onwuegbuzie and Turner (2007, p.123) and quoted by Flick (2014 , p.36) “mixed method is the type of research in which a researcher or a team of researchers combines elements of qualitative and quantitative research approaches” wherein this paper a systematic literature review was employed to verify the literature of both areas: risk management and agile project management in general and Scrum in specific. The literature review materials consisted of peer-reviewed articles from accessible online databases, in addition to a few books about research areas. The purpose of this review is to build the theoretical basis of the proposed framework and to justify its need.

The output of the literature review was manipulated, reformed, and utilized to build the targeted Scrum framework of risk management proposal. Seeking to test the hypothesis of this paper, a questionnaire was constructed to examine risk management and agile project management professionals' opinion of the proposed framework and its benefit to the risk management field.

## **5.6 Research Tools**

Literature is abundant with various research tools that could be useful for research work. However, the researcher has to be selective to adopt whatever suitable for his research. In the following sections, few research tools will be reviewed.

### **5.6.1 Survey**

Newell (1993) argued that it would be feasible and cost-effective to employ mailed surveys whenever a large sample is required who are distributed over a large geographical area. However, it takes longer than direct communication methods like telephonic surveys (Newell 1993). Such an approach would help to eliminate researcher bias, as there are no direct interactions between a researcher and respondents. Nevertheless, it also limits the capability of obtaining more comprehensive answers from respondents. A wide range of other information collection methods is well documented in the literature, where the following are a few (Newell 1993):

- 1- Literature reviews: this comprises a review of accessible and reachable materials resources from printed books, magazines, conferences' papers, databases...etc. This could be considered an economical approach, but it has its challenges of getting enough resources and getting the right support at the right time.
- 2- Interactions with experts: this approach includes collecting data from an expert through attending seminars and expert gatherings. This would help researchers to reach out to the actual sources of information and gain information that might not be available in a public environment or not yet published to open literature. Nevertheless, it is extremely subjective and might not be demonstrative as a whole.

- 3- Focus group: this approach is employed to investigate people's thoughts, perceptions, beliefs, and behaviors to validate new ideas or approaches. Nevertheless, this method is found to be costly, time-consuming, and may not generate representative results.
- 4- Interviews: Interviewing a sample of an audience whose size and variety would be defined based on the nature of the study to obtain in-depth understanding and various views for the topic of concern. This method is also known to be costly and time-consuming.
- 5- Telephonic Surveys were found to be effective and cost-efficient, where the targeted information is related to personal perceptions.
- 6- The online survey is another method that is widely used recently. It has the advantages of a mailed survey, but in a more cost-efficient manner. The low response rate a well-known drawback for such a method.

In this study, a systematic literature review is employed to collect the necessary information to build the targeted framework and form a questionnaire that would help to obtain experts' opinions about the proposed frameworks and its impact.

### **5.6.2 Questionnaire**

As defined by Parasuraman and his colleagues (1991), a questionnaire is formed of a predefined set of queries that aims to collect specific data that a researcher might need to reach out to the study goals. It is featured to be the fastest method to collect statistical data effectively. This questionnaire would be distributed to a targeted audience, where completed surveys would be collected, audited, qualified, and analyzed to obtain the aimed results.

Many authors like Dawson (2009) and Burns and Burns (2008) have studied the pros and cons of a written questionnaire over other methods, where the following represents a summary of their outcomes:

Pros:

- 1- Offering respondent, freedom to express his opinion without being led or misled by the researcher bias.
- 2- The anonymity of respondents, especially in online surveys which encourages respondents to speak their hearts freely.
- 3- A well-designed survey would efficiently help a researcher to address a wide range of issues effectively with the possibility of getting a high response rate of the audience is appropriately selected.
- 4- It is considered to be a cost-effective and efficient method of data collection.
- 5- Questionnaire output usually is handled and analyzed easily using standard software tools that are widely available and not costly.

Cons:

- 1- Surveys might represent inaccurate results if the audience is not selected properly.
- 2- Surveys might offer misleading information in case it was not appropriately designed, or its questions missed sufficient clarity on its target.
- 3- Surveys might lack flexibility, as it does not offer a way to verify respondent understanding, interact with them, or any other follow up means with respondents.
- 4- Questionnaire may face difficulties in obtaining a proper response rate, which would affect the confidence level of its result.

### **5.6.3 Research Questionnaire Design and Implementation**

A common trap that almost every new researcher will fall in was ignoring the importance of the questionnaire design and implementation process and treated as a trivial process that does not require much attention. This issue was adequately captured in literature where emphasizes the importance of how to build a questionnaire, how to design it, how to distribute and how to collect the responses

to achieve the aimed targets and produce high-quality data that are easily marked in literature. Achieving an appropriate response rate as well as collecting accurate, precise, and high-quality data are the main goals that shall be born in mind while preparing any questionnaire. In the following sections, general highlights this work questionnaire design and implementation would be reviewed.

#### **5.6.3.1 Questionnaire Structure:**

The questionnaire consisted of 3 parts: part one was general demographic questions which focus is to get general information that would help a researcher to under his audience, part two focused on the proposed Scrum risk management framework, and part three was focused on examining people opinion of Scrum risk management framework efficiency compared to traditional risk management methodology. The questions of parts two and three were formed on a Likert scale of 5 levels from strongly agree to strongly disagree with facilitating to the respondent to express their agreement on the area of concern.

#### **5.6.3.2 Questionnaire Media:**

Using online methods to collect questionnaire responses is gaining more interest from researchers as well as respondents due to the flexibility and efficiency it offers (Bryman & Bell 2011). Nowadays, online surveys are highly considered by the researcher due to the fact that it helps them overcoming geographical constraints, where a researcher can run a worldwide survey from his desk. This would also help to reduce the research funding requirements; especially, in the countries where academic research is not well funded.

For this research, online questionnaire was considered, where the questionnaire was built on one of the popular online survey websites, and a weblink was shared with the anticipated respondents to complete the survey at their convenience.

### **5.6.3.3 Covering Letter**

As a part of a researcher's efforts to enhance and improve the response rate to his survey, covering letter serves as one of the best tools to achieve this target. A well-constructed, precise, short and comprehensive covering letter represents a tactful invitation to respondents to participate in a questionnaire and happily spare a time to go through and answer all the questions. This perception of the importance of covering letter is heavily adopted in literature where researchers think that it makes differences (Bissett 1994; Leung 2001). However, there are still voices who are adopting and quoting Calvert perception, which was presented in 1963 that covering letters do not influence response rates.

Unlike the traditional questionnaire mailing process where research used to comment on the effect of hand-signature and the color of the used ink on the response rate (Drever & Munn 1999), online questionnaire eliminated such discussion. Nevertheless, it does not reduce the importance of the cover letter itself. In this study, covering letter was carefully considering addressing the following concerns:

- 1- Providing respondents with a high-level description of the area of concern addressed in this questionnaire.
- 2- Confirming the privacy of respondents, the anonymity of their identities, and the confidentiality of their responses.
- 3- Providing respondents with a quick highlight of the structure of the survey.

### **5.6.3.4 Questionnaire Distribution Process**

In addition to the traditional distribution mechanism where survey link was shared with professional individuals via direct email invitation from the researcher, a professional networking platform, specifically LinkedIn, was utilized to distribute the questionnaire to the largest possible audience. The questionnaire was shared through closed LinkedIn groups, which are restricted either to risk management professionals or agile management professionals as a targeted audience.

## **5.7 Study Audience General Information**

Initially, any research would be designed to incorporate the maximum possible number of responses to obtain various opinions covering the different aspects of the area of concern. This variety of perceptions would help researchers reaching out to reliable conclusions. However, due to the practical limitations of approaching the full audience, sampling would represent a feasible, practical solution for this. As opined by Brase and Brase (2011), in theory, a sample (n) represents a sub-group of the population (N). Kuzel (1992) suggested that once a representative sample is surveyed, the outcome of their responses could be generalized to the whole population. As argued by Flick (2014), the representativeness of the sample is the main criteria of the formal sample (quantitative sampling), where random sampling is employed to offer every single individual in the audience an equal chance of participating in a survey.

## **5.8 Sampling Technique: Stratified Sampling**

The possibility to use stratified sampling technique was considered, where the researcher studied the possibility of designing a two-stage approach. In the first stage, information to be collected about anticipated participants. Then, in the second stage, nominated participants to be selected (Naoum 2012). However, due to the time and cost demands of such a technique, it was found not feasible for this work.

### **5.8.1 Sampling Technique: Stratified Random Sampling**

Random sampling technique allows the researcher to select the target population and offer them a statistically equal chance to participate in the researcher (Suri 2011). Realistically speaking, it is almost impossible to engage all the targeted population in the research; researchers tend to add a constraint to define a more specific sub-group of the population to participate in their study which is known as stratified random sampling. For example, researchers who are studying a particular

area of knowledge might restrict their population to a specific geographical area similar to what Elbanna (2013) did when he selected his population to be employees working for companies in 3 emirates in the United Arab Emirates (UAE). In other scenarios, the restriction might be related to the type of organization participant is working for, like what Brière et al. (2015) did when they examined project management practices in non-governmental entities. Ultimately, using stratified random sampling is very common in recent literature, as it helps researchers to demonstrate their perspectives about a specific topic in a particular population (Marshall 1996).

In this research, aiming to obtain a representative result, random sampling was employed. The study targeted population is risk management and agile management professionals. However, due to time and cost limitations to reach out to the targeted population, stratified random sampling was adopted where the population was restricted to risk and agile professionals who are part of certain closed groups on LinkedIn. In order to achieve this, the questionnaire was shared by posting the questionnaire link on these closed LinkedIn groups. As argued by Field (2013), the larger the sample size is, the more powerful and representative it is. De Vaus (1996) suggested that a sample size of 100+ participants is sufficient to conduct statistical analysis and draw conclusions with a proper confidence level that could be utilized to generalize the findings to the whole population. Accordingly, 120 participants were set to be the minimum acceptable sample size for this work.

## **5.9 Questionnaire Validation**

### **5.9.1 Design of Questionnaire**

The main aim of running the questionnaire was to rank respondents' perspectives about employing Scrum Methodology to perform risk management activities and how this could affect the efficiency of risk management. The questionnaire was designed so that each section would measure respondents' perspectives in a specific area of risk management and how to reflect Scrum methodology on this

particular process of risk management. The questions in these sections were built based on the idea of applying the full Scrum cycle as defined by its founders: Schwaber and Sutherland on each of the four processes of risk management (identification, analysis, response planning, monitoring and controlling) and proposing a Scrum role for each of a project's members. In the last section was designated to measure respondents' opinion about the impact which Scrum might introduce to the efficiency of the overall risk management, where a risk management scenario was proposed for each of set agile management tools and techniques which were identified during the literature review and the respondents were requested to rate their opinion on a Likert scale of 5 levels on whether these tools and techniques would help to improve the efficiency of risk management or not.

### **5.9.2 Pilot Questionnaire**

As a last check before proceeding with the survey, a pilot survey that had the initial version of the questionnaire was distributed to a limited number of trusted subject matter experts for their feedback. As suggested by Bryman and Bell (2011), a pilot survey would help researchers' improving the quality of their questionnaire and eliminating any unintended errors. Several valuable feedbacks were received advising improvement on the wording of a few questions, selected format of questions, etc.

### **5.9.3 Collected Data Analysis and Results**

Respondents' perception of the proposed Scrum risk management framework and the influence of agile tools and techniques on risk management performance was explored using five-step Likert scale questions in the survey. The collected data were statistically analyzed using: reliability test (Cronbach's alpha), descriptive analysis, and one-way ANOVA, in order to derive the conclusions.

Cronbach’s alpha test was carried for each of the four sections of part 2 of the questionnaire and for part 3, in order to check the internal consistency in each of these sections. Results are shown in Table 10:

Table 10 Reliability Test Results

Risk Identification Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.891	.891	14
Risk Analysis Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.893	.893	12
Risk Response Planning Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.887	.887	12
Risk Monitoring and control Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.913	.914	12
Risk Management Performance Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.855	.856	8

The value of Cronbach’s alpha for the different sections was greater than 0.8, which indicates a high level of reliability for the collected data and a high inter-consistency of all the scales (Field 2013).

In the next chapters, findings of the questionnaire will be listed, results of the statistical analysis will be discussed in detail and analyzed to derive the conclusion of this study.

## 6 Findings

The survey was conducted on a virtual professional network (LinkedIn) targeting professionals in risk management and agile management fields. Due to time limitations, the survey was closed after reaching 442 responses. Responses were reviewed, and 159 responses were qualified, which is considered satisfactory as it is larger than the minimum sufficient sample size of 100, as suggested by De Vaus (1996) and larger than the minimum targeted size of 120. 68% of the participants were identified as male and 32% as females, which gives an indication about the gender ratio of such professions. The survey showed that almost 58% of the participants hold post-graduate degrees: 50% of masters degree holders and 8% Ph.D. degree holders. The balance 42% of participants identified themselves as Bachelor's degree holders. 33% of the participants identified themselves as construction industry professionals, 23% identified themselves as risk management professionals, and 44% identified themselves as software development professionals. From seniority perspective, less than 4% identified themselves as junior staff, less than 12% identified themselves as senior staff, less than 23% identified themselves as junior management, less than 43% identified themselves as middle management and less than 19% identified themselves as top management. Looking into participants project management experience, 26% classified their project management experience to be below 5 years, 46% classified their experience to be higher than 6 years but less than 10 years, 20% classified their experience between 11-15 years and only 8% classified their project management experience to be more than 15 years. Risk management experience ratios were distributed in almost a similar manner where 27% categorized their expertise in risk management to be less than 2 years, 44% categorized their experience between 3-5 years, 23% categorized their experience to be higher than 6 years and less than 10 years and 6% categorized their experience more than 10 years. Agile experience reporting had almost a similar percentage when it comes to 3-5 years of experience, where nearly 46% of the participants reported their agile expertise in this range. However, it showed a higher percentage in the category of 0-2 years of agile experience, which was reported by 33% of the participants. 16% reported their agile experience to be above 6 years but less than 10 years. While

around 4% only reported their agile expertise above 10 years. Almost 79% of the participants were distributed almost equally on two categories of Scrum experience, which were 0-2 years and 3-5 years of experience. 17% reported their experience to be above 6 years and below 10 years, and similar to agile experience distribution, around 4% only reported their Scrum experience to be more than 10 years. The participants have skills with different project sizes where 25% of the respondents reported experience with projects whose values less than one million AED, 47% reported an experience with projects whose values are 1-10 million AED, 19% claimed experience with projects whose values are 11-50 million AED and only 9% claimed experience with projects whose values are greater than 50 million AED.

Schwaber & Sutherland (2017) and Cervone (2011) suggested that Scrum is not only a software development management tool, but also Scrum is an agile management tool that applies to any iterative and incremental process regardless of its field or its final product. The results of this this questionnaire supported Schwaber, Sutherland and Cervone suggestion where 79% of the respondents were in favor of this principle. Furthermore, 74% of the respondents agreed to Merna & Al-Thani (2008), Hopkin (2017), Perminova, Gustafsson & Wikström (2008) PMI (2013) and PMI (2009) statement that risk management is an iterative and incremental process. These two principles urged the research to look into the feasibility of using Scrum principles to run risk management applications and evaluate the anticipated influence on risk management efficiency.

The data collected from the second part, and the third part were analyzed using descriptive analysis and one-way ANOVA. In the next section, descriptive analysis of the second and the third part:

### 6.1 Descriptive Analysis Results:

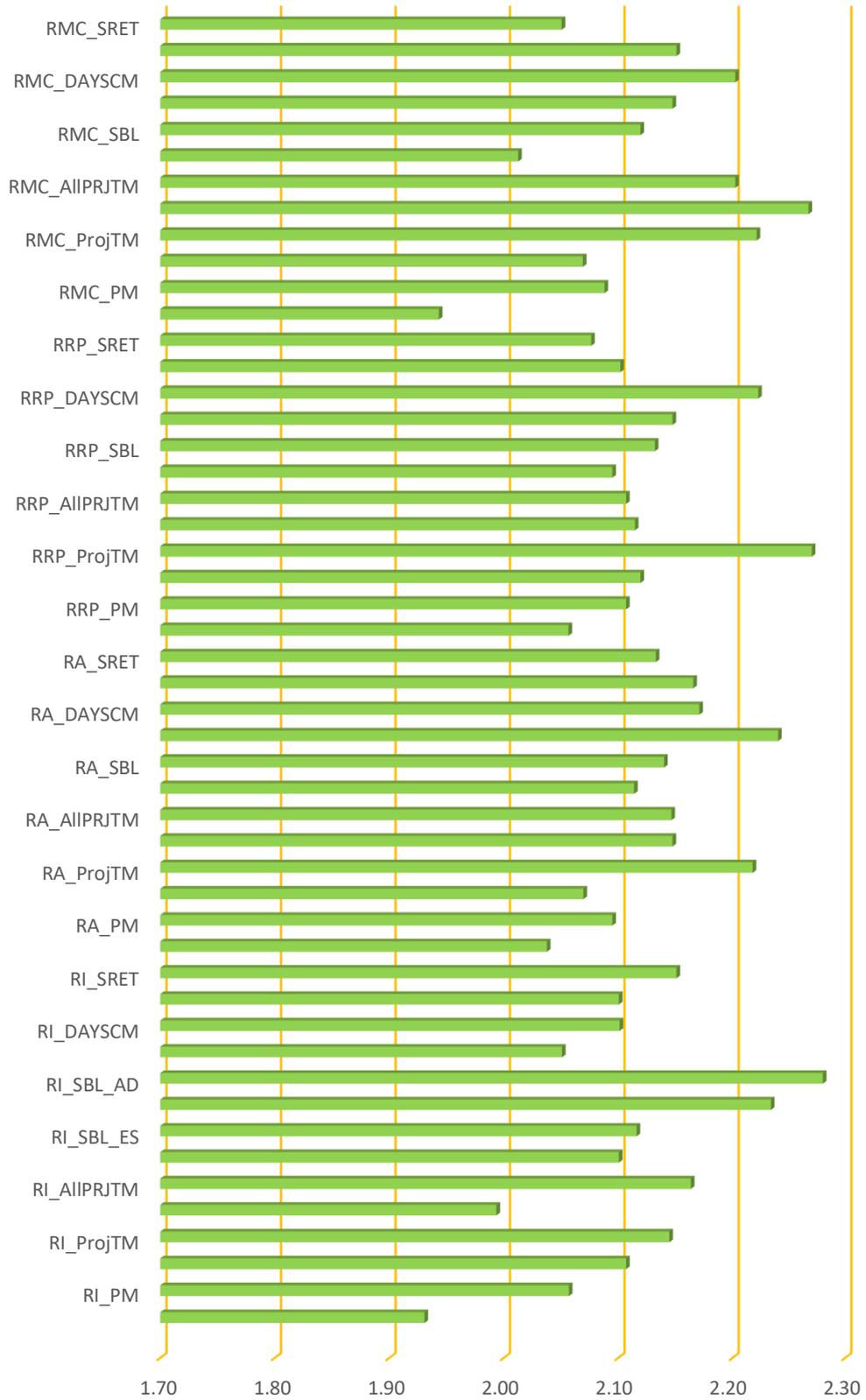
In The second part of the survey, participants' perception of using Scrum methodology to run each of the four processes of risk management was captured using Likert scale questions where strongly agree was coded as 1 and strongly disagree was coded as 5. The results were analyzed and reported, as shown in Table 11.

Table 11 Scrum Risk Management

	Mean	Std. Deviation	Variance
RI_PB	1.93	.730	.533
RI_PM	2.06	.854	.729
RI_RMen	2.11	.816	.666
RI_ProjTM	2.14	.906	.821
RI_CFTM	1.99	.767	.589
RI_AllPRJTM	2.16	.892	.796
RI_SP	2.10	.828	.686
RI_SBL_ES	2.12	.868	.753
RI_SBL_Sec	2.23	.875	.766
RI_SBL_AD	2.28	.838	.703
RI_SDUR	2.05	.766	.587
RI_DAYSCHM	2.10	.831	.690
RI_SREV	2.10	.828	.686
RI_SRET	2.15	.813	.661
RA_PB	2.04	.803	.644
RA_PM	2.09	.835	.698
RA_RMen	2.07	.799	.638
RA_ProjTM	2.22	.875	.765
RA_CFTM	2.15	.849	.720
RA_AllPRJTM	2.15	.868	.754
RA_SP	2.11	.937	.879
RA_SBL	2.14	.866	.749
RA_SDUR	2.24	.885	.783
RA_DAYSCHM	2.17	.808	.652

RA_SREV	2.17	.883	.780
RA_SRET	2.13	.868	.753
RRP_PB	2.06	.748	.560
RRP_PM	2.11	.768	.590
RRP_RMen	2.12	.860	.739
RRP_ProjTM	2.27	.926	.857
RRP_CFTM	2.11	.884	.782
RRP_AllPRJTM	2.11	.861	.742
RRP_SP	2.09	.851	.723
RRP_SBL	2.13	.812	.660
RRP_SDUR	2.15	.856	.733
RRP_DAYSCM	2.22	.821	.674
RRP_SREV	2.10	.841	.707
RRP_SRET	2.08	.813	.661
RMC_PB	1.94	.757	.573
RMC_PM	2.09	.845	.714
RMC_RMen	2.07	.835	.698
RMC_ProjTM	2.22	.879	.772
RMC_CFTM	2.27	.865	.748
RMC_AllPRJTM	2.20	.865	.749
RMC_SP	2.01	.806	.650
RMC_SBL	2.12	.881	.777
RMC_SDUR	2.15	.878	.772
RMC_DAYSCM	2.20	.894	.799
RMC_SREV	2.15	.894	.800
RMC_SRET	2.05	.835	.698

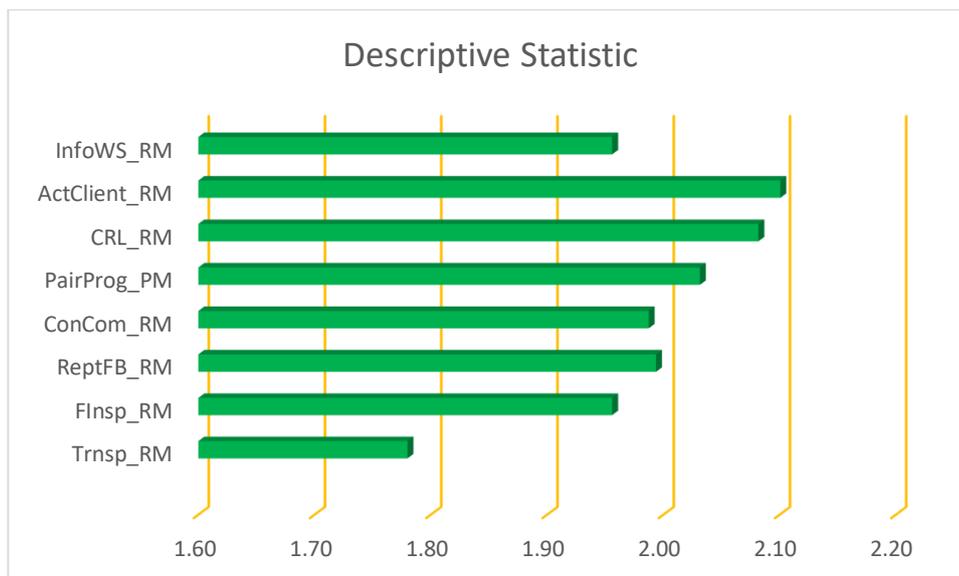
## Descriptive Statistic



The responses of the participants for section three, which was designed to measure the respondents' perceptions for the influence that agile methodologies feature and techniques can have on the efficiency of the risk management process, were reported and analyzed, as shown in Table 12.

Table 12 Agile methodology influence on risk management efficiency

	Mean	Std. Deviation	Variance
Trnsp_RM	1.78	.708	.502
FInsp_RM	1.96	.749	.561
ReptFB_RM	1.99	.784	.614
ConCom_RM	1.99	.879	.772
PairProg_PM	2.03	.822	.676
CRL_RM	2.08	.886	.784
ActClient_RM	2.10	.901	.813
InfoWS_RM	1.96	.814	.663



## 6.2 One-Way ANOVA Analysis Results

Seeking a more robust conclusions, further analysis of the results of the survey were considered looking into the difference between the perception of the various respondents' categories about the research hypothesis. Aiming to differentiate between the perception of different populations, i.e., their responses' means, ANOVA was found to be a suitable vehicle for such a test, as suggested by Aczel and Sounderpandian (2008). A further advantage opined by Moore and Dixon (2015), where he claimed that ANOVA would help researchers as a tool to measure the confidence level in all conclusions under study. Moore and Dixon (2015) suggested that ANOVA has to be implemented in two steps. In the first steps, research would be looking for sufficient evidence of a considerable difference between the responses of the various groups. Then, further analysis can be undertaken to measure how big or small the difference is. In the coming section, ANOVA test would be employed to identify if there is significant similarity or difference between the respondents' perceptions about the research hypothesis based on their education level, field of work, seniority level, project management experience, risk management experience, and agile management experience. Preparing for ANOVA test, the research hypothesis restated in table 13 below in ANOVA null hypothesis format. The test would be run using SPSS, considering a significance cut off point of 0.05.

Table 13 ANOVA test null hypothesis

It is feasible to use Scrum framework to run risk management application	
Accepted null hypothesis: Sig. >0.05	There is no statistically difference among respondents' perceptions of the feasibility of using Scrum framework to run risk management applications.
Rejected null hypothesis: Sig. >0.05	There is statistically difference among respondents' perceptions of the feasibility of using Scrum framework to run risk management applications.

Agile principles, tools, and techniques would improve the efficiency of risk management application	
Accepted null hypothesis: Sig. >0.05	There is no statistically difference among respondents' perceptions on the positive influence of agile principles, tools, and techniques on the efficiency of risk management application
Rejected null hypothesis: Sig. >0.05	There is a statistically difference among respondents' perceptions on the positive influence of agile principles, tools, and techniques on the efficiency of risk management application

ANOVA test was run using alpha value of 0.05. Results were reported as shown in table 14.

Table 14 ANOVA Test Results

Null Hypothesis no. 1

Gender

		Sum of Squares	df	Mean Square	F	Sig.
RM_SCRUM	Between Groups	849.605	1	849.605	1.245	.267
	Within Groups	88026.365	129	682.375		
	Total	88875.969	130			

Education Level

RM_SCRUM	Between Groups	1643.287	2	821.643	1.206	.303
	Within Groups	87232.683	128	681.505		
	Total	88875.969	130			

Field of Work

RM_SCRUM	Between Groups	936.389	2	468.194	.681	.508
	Within Groups	87939.581	128	687.028		
	Total	88875.969	130			

Seniority Level

RM_SCRUM	Between Groups	3415.281	4	853.820	1.259	.290
	Within Groups	85460.688	126	678.259		
	Total	88875.969	130			

Project Management Experience

RM_SCRUM	Between Groups	382.183	3	127.394	.183	.908
	Within Groups	88493.787	127	696.801		
	Total	88875.969	130			

Risk Management Experience

RM_SCRUM	Between Groups	373.480	3	124.493	.179	.911
	Within Groups	88502.489	127	696.870		
	Total	88875.969	130			

Agile Management Experience

RM_SCRUM	Between Groups	3332.616	3	1110.872	1.649	.181
	Within Groups	85543.354	127	673.570		
	Total	88875.969	130			

Null Hypothesis no. 2

Gender

	Sum of Squares	df	Mean Square	F	Sig.
Scrum_Risk_Perf orm	1.119	1	1.119	.052	.820
Between Groups					
Within Groups	3374.843	157	21.496		
Total	3375.962	158			

Education Level

Scrum_Risk_Perf orm	80.977	2	40.488	1.917	.151
Between Groups					
Within Groups	3294.986	156	21.122		
Total	3375.962	158			

Field of Work

Scrum_Risk_Perf orm	33.753	2	16.877	.788	.457
Between Groups					
Within Groups	3342.209	156	21.424		
Total	3375.962	158			

Seniority Level

Scrum_Risk_Perf orm	214.560	4	53.640	2.613	.038
Between Groups					
Within Groups	3161.402	154	20.529		
Total	3375.962	158			

Project Management Experience

Scrum_Risk_Perf orm	53.533	3	17.844	.832	.478
Between Groups					
Within Groups	3322.430	155	21.435		
Total	3375.962	158			

Risk Management Experience

Scrum_Risk_Perf	Between	82.031	3	27.344	1.287	.281
orm	Groups					
	Within	3293.931	155	21.251		
	Groups					
	Total	3375.962	158			

Agile Management Experience

Scrum_Risk_Perf	Between	119.373	3	39.791	1.894	.133
orm	Groups					
	Within	3256.589	155	21.010		
	Groups					
	Total	3375.962	158			

## 7 Discussion

### 7.1 Descriptive Analysis Results Discussion

The results of the descriptive analysis of data collected for part two of the survey, which measures the participants' perception about using agile framework to run risk management application, showed general acceptance for the proposed framework of using Scrum to run risk management with mean values between 1.7 to 2.3 and standard deviation values between .730 to .926 as shown in table 11. Part two of the survey consists of four sections, each of which is designed to measure respondents' agreement on using Scrum methodology to run each step of the four primary processes of risk management using a Likert scale where "strongly agree" was coded with 1 and "strongly disagree" was coded with 5. In the first section of part two of the survey, questions were designed to measure the respondent's perception of using Scrum methodology to run risk identification process. The responses showed a positive stand from the proposed framework to run risk identification with mean values as high as 1.93 with a standard deviation of 0.73 for using the product backlog concept to define the area for which risks to be identified, and as low as 2.28 with a standard deviation of 0.838 for using risk register as Sprint backlog where the Sprint would aim to update this risk register. It can be noted that using the concept of product backlog for risk management processes: risk identification, risk assessment, risk response planning, and risk monitoring and control, recorded the minimum mean value in each process where its values were: 1.93 with a standard deviation of 0.73, 2.04 with a standard deviation of 0.803, 2.06 with a standard deviation of 0.748 and 1.94 with a standard deviation of 0.757, respectively. This outcome is reasonable, especially when we realize that this step corresponds to preparing the input of each risk management process where the product backlog format would help the team to identify a clear, comprehensive, and particular input. The importance of this step is that it represents a crucial success factor in risk management (PMI 2017). The least supported points were with a mean of 2.28 with a standard deviation of 0.838, 2.24 with a standard deviation of 0.885, 2.27 with a standard deviation of 0.926 and 2.27 with a standard deviation of 0.865 for Scrum risk identification, Scrum risk

assessment, Scrum risk response planning, and risk monitoring and control, respectively. There was a variety of responses for the least supported points. However, it was mainly around the team selection, sprint backlog, and sprint duration within the different processes of risk management. Nevertheless, 2.28 as a mean still showed overall support to the suggested framework.

With mean values from 1.78 with a standard deviation of 0.708 to 2.10 with a standard deviation of 0.901, the data collected from part 3 of the survey showed that respondents had a strong belief in the benefits which agile methodology can introduce in risk management by applying its concepts and techniques. Transparency showed the minimum mean with a value of 1.78 with a standard deviation of 0.708. This outcome is in line to emphasis of practitioners and literature on the importance of sharing the latest information about risks with the whole team (Merna & Al-Thani 2008; Hopkin 2017, PMI 2009) and at the same time, it is one of the pillars of Scrum (Schwaber and Sutherland 2017). Other points like frequent inspections, repetitive feedback cycles, continuous communication, and informative workplace had mean values less than 2.00. PMI emphasized on the importance of these points where it is covered directly and indirectly under the identified success factors of risk management (PMI 2009). Active client involvement was the least supported point with a mean value of 2.10 and a standard variation of 0.901. This can be justified by the fact that risk management as a process is an internal measure within the project team or the organization team and does not involve the client in typical scenarios (Merna & Al-Thani 2008; Hopkin 2017, PMI 2009). However, the benefit of working with an active client is still perceived by the respondents considering the mean of 2.10. The benefits of applying agile management tools and techniques in none software development projects were captured as well in literature. Gustavsson (2016) had addressed this topic when he analyzed the benefits of using agile methodologies in 21 manufacturing projects. He reported remarkable benefits, especially when it comes to teamwork, client interaction, efficiency, and flexibility, which represent elementary tools and techniques for agile management.

## 7.2 ANOVA Test Results Discussion

Based on the outcome of table 14, it would be noticed that the test showed no statistically significant difference in respondents' perceptions about both hypotheses whenever the comparison was based on gender, education level, field of work, project management experience, risk management experience and agile management experience. Hence, null hypothesis was accepted in all these cases. However, on the basis of seniority, the test showed that there is no statistically difference in respondent's perceptions about the feasibility of using Scrum framework to run risk management applications. But it showed a statistically difference in respondent's perceptions about the positive influence of agile principles, tools, and techniques on the efficiency of risk management application where the P-value was 0.038 as per table 14, i.e., less than the significant value of 0.05. This might be due to the fact that people with different seniority levels would have a different perception of risks and risk application performance measures. Nevertheless, seeking for more detailed information about the variance of perceptions according to the seniority level, the survey results were tested using Tukey test, which presents one of the Honest Significant Difference tests (HSD). Tukey test results are shown in Table 15.

Table 15 Tukey test results based on seniority level

Tukey HSD<sup>a,b</sup>

Seniority Level	N	Subset for alpha = 0.05	
		1	2
Middle Management	68	14.9412	
Top Management	30	15.4333	15.4333
Senior Staff	19	16.4211	16.4211
Junior Management	36	17.1389	17.1389
Junior Staff	6		19.6667
Sig.		.621	.056

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.943.

b. The group sizes are unequal. The harmonic mean of the group sizes is used.

Type I error levels are not guaranteed.

Tukey test results, as shown in Table 15 showed that there is no honest significant difference between respondents' perception of the positive influence of agile principles, tools, and techniques on the efficiency of risk management application. For further confidence, a post hoc test was conducted. Multiple comparison results shown in Table 16 confirmed that the Tukey test results. Accordingly, null hypothesis shall be accepted.

Table 16 Multiple comparisons results

Dependent Variable: Scrum\_Risk\_Perform

Tukey HSD

(I) Sen	(J) Sen	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Junior Staff	Senior Staff	3.24561	2.12176	.545	-2.6112	9.1025
	Junior Management	2.52778	1.99792	.713	-2.9872	8.0428
	Middle Management	4.72549	1.92959	.108	-.6009	10.0519
	Top Management	4.23333	2.02626	.230	-1.3599	9.8265
Senior Staff	Junior Staff	-3.24561	2.12176	.545	-9.1025	2.6112
	Junior Management	-.71784	1.28479	.981	-4.2643	2.8287
	Middle Management	1.47988	1.17573	.717	-1.7656	4.7253
	Top Management	.98772	1.32843	.946	-2.6792	4.6547
Junior Management	Junior Staff	-2.52778	1.99792	.713	-8.0428	2.9872
	Senior Staff	.71784	1.28479	.981	-2.8287	4.2643
	Middle Management	2.19771	.93388	.134	-.3801	4.7756

	Top Management	1.70556	1.12006	.549	-1.3862	4.7973
Middle Management	Junior Staff	-4.72549	1.92959	.108	-10.0519	.6009
	Senior Staff	-1.47988	1.17573	.717	-4.7253	1.7656
	Junior Management	-2.19771	.93388	.134	-4.7756	.3801
	Top Management	-.49216	.99306	.988	-3.2334	2.2491
Top Management	Junior Staff	-4.23333	2.02626	.230	-9.8265	1.3599
	Senior Staff	-.98772	1.32843	.946	-4.6547	2.6792
	Junior Management	-1.70556	1.12006	.549	-4.7973	1.3862
	Middle Management	.49216	.99306	.988	-2.2491	3.2334

The results of the ANOVA test shows a high level of awareness among risk management and agile management practitioner, irrespective of their gender, education background, field of work , experience or seniority level, of the importance of looking for more agile, adaptive and change tolerant methodology to run our traditional business to be able to cope with changing pace of today's world.

The outcome of both descriptive analysis test and ANOVA test supports the claim of Scrum founders Schwaber and Sutherland (2017) that Scrum is meant to be a management tool for any product and not specifically for software development projects. Not only this, but also, it supports the claim of Solinski & Petersen (2014) and Azanha et al. (2017) that agile methodology would help in many ways to improve the efficiency of the process where it is applied. Literature has evidence that agile generally and Scrum specifically could be a successful management tool for none software development projects. The successful expanding usage of agile

methodology for none software development projects was also captured by Beaumont et al. (2017), where they reported an increase in the successful deployment of agile methodology in engineering, research, and development projects. On the other hand, other studies like the one carried by Jeff Totten (2017) showed that implementation of agile methodology in a none software development projects has many success stories where he studied its success factors. He claimed that management support, clear vision, and willingness to change represent significant success factors.

## 8 Conclusion

Every era of human history was featured with a dominant event, an invention, or a disruptive action. For ages, humans were working hard to manage and control their world through fixed and firm rules, roles, standards, plans, etc. However, with a changing world, traditional management is not the key to success any more (Meredith & Francis 2000). The financial sector was the first to pay attention to the risks associated with the frequent changes where they introduced risk management concept and processes into their industry in the eighteenth century (Merna & Al-Thani 2008). Two hundred years later, project management practitioners and academics realized the added value of introducing risk management concept into project management area of knowledge where risk management process was standardized and become an essential part of any project management literature piece (Merna & Al-Thani 2008; Hopkin 2017).

With all the changes that happened to our world today and the fast pace of changes, being proactive, willing to change, open to learning, flexible, and adaptable become the key to success (Meredith & Francis 2000). Software development professionals were the first to address the need for a more flexible and adaptable management methodology, which would help them to be more agile to their fast-changing environment (McAvoy & Sammon 2005). Software development professionals introduced multiple agile management frameworks like Extreme Programming, DSDM, ASD, Scrum ...etc. (Cervone 2011). However, Extreme Programming and Scrum are the most utilized agile methodologies (Cervone 2011; Barlow et al. 2011; Jalali & Wohlin 2012; Hummel 2014). Unlike other agile methodology founders, Schwaber and Sutherland (2017) focused their efforts to introduce a universal agile management methodology that would serve any product or application that is iterative and incremental. Thus, they introduced Scrum.

The importance of risk management is increasing in the different sectors and industries, which forms today's world, and the attention to ensure proper practices

of risk management is growing. PMI standard practice of risk management, COSO, ISO Guide 73, and ISO 31000 are examples of issued standards and frameworks of risk management, in which risk management is featured as an iterative and incremental process (PMI 2009; Hopkin 2017; Gray, Larson & Desai 2013).

In this paper, the feasibility of using Scrum methodology to run risk management applications and the effect of applying agile management methodologies tools and techniques on risk management efficiency were studied, and survey was released to measure risk management and agile management professionals' perceptions of the research questions. After collecting and analyzing the survey responses, it was concluded that professionals support utilizing Scrum framework to run none software development applications generally and risk management applications specifically. Also, it was found that the professional believes that applying agile management tools and techniques would help to improve the performance of risk management.

Despite the fact that this paper concluded that it is feasible to utilize Scrum tools and techniques for none software development application and the positive influence that agile tools and techniques have on the area where it is applied, this would need a practical proof through running pilot risk management projects using the proposed Scrum framework and measure the success and performance of these projects compared to traditional risk management methodology and define areas of improvement to the proposed framework. Furthermore, agile management application in none software development applications, especially Scrum management, is a fertile field of study and research that would help researchers and professionals to improve the way we manage our projects and business today.

## 9 References

- Abdou, A., Lewis, J. & Alzarooni, S. (2004). Modelling Risk for Construction Cost Estimating and Forecasting: a Review. *Association of Researchers in Construction Management*.
- Aczel, A. & Sounderpandian, J. (2008). *Complete Business Statistics*. Seventh Ed. The Mcgraw-hill/Irwin Series.
- AIRMIC Alarm IRM. (2010). A structured approach to Enterprise Risk Management (ERM) and the requirements of ISO 31000 Contents. *Risk Management*.
- Alsahli, A., Khan, H. & Alyahya, S. (2017). Agile Development Overcomes GSD Challenges: A Systematic Literature Review. *International Journal of Computer Science and Software Engineering (IJCSSE)*, vol. 6(1), pp. 7–18.
- Azanha, A., Argoud, A. R. T. T., de Camargo Junior, J. B. & Antonioli, P. D. (2017). Agile project management with Scrum: A case study of a Brazilian pharmaceutical company IT project. *International Journal of Managing Projects in Business*.
- Barlow, J. B., Giboney, J. S., Keith, M. J., Wilson, D. W., Schuetzler, R. M., Lowry, P. B. & Vance, A. (2011). Overview and guidance on agile development in large organizations. *Communications of the Association for Information Systems*.
- Beaumont, M., Thuriaux-Alemán, B., Prasad, P. & Hatton, C. (2017). Using agile approaches for breakthrough product innovation. *Strategy and Leadership*.
- Besner, C. & Hobbs, B. (2012). The paradox of risk management; a project management practice perspective. *International Journal of Managing Projects in Business*.
- Bissett, A. F. (1994). Designing a questionnaire: Send a personal covering letter. *BMJ*.

- Brase, C. H. & Brase, C. P. (2011). *Understanding Basic Statistics*. Sixth Edit. Thomson Brooks/Cole.
- Brière, S., Proulx, D., Flores, O. N. & Laporte, M. (2015). Competencies of project managers in international NGOs: Perceptions of practitioners. *International Journal of Project Management*.
- Bryant, C. G. A. (1985). *Positivism in Social Theory and Research*. First Edit. Macmillan International Higher Education.
- Bryman, A. (2012). Social research methods Bryman. *OXFORD University Press*.
- Bryman, A. & Emma Bell. (2011). *Business Research Methods (3rd edition)*. Oxford University Press.
- Bulmer, M. (1982). When is disguise justified? Alternatives to covert participant observation. *Qualitative Sociology*.
- Burns, R. & Burns, R. P. (2008). *Business Research Methods and Statistics Using SPSS*. SAGE Publications.
- Calvert, R. (1963). *Career Patterns of Liberal Arts Graduates*. Carroll Press.
- Cervone, H. F. (2011). Understanding agile project management methods using Scrum. *OCLC Systems and Services*.
- Collier, P. M. (2009). *Fundamentals of risk management for accountants and managers: Tools and techniques*. *Fundamentals of Risk Management for Accountants and Managers: Tools and Techniques*.
- Corbett, R. B. (2004). A View of the Future of Risk Management. *Risk Management*, vol. 6, pp. 51–56.
- Creswell, J. W. (2009). Qualitative, Quantitative, and Mixed Methods Approaches The Selection of a Research Design. *Research design*.

- Da Silva, T. S., Martin, A., Maurer, F. & Silveira, M. (2011). User-centered design and agile methods: A systematic review. *Proceedings - 2011 Agile Conference, Agile 2011*.
- Dawson, C. (2009). *Introduction to Research Methods: A practical guide for anyone undertaking a research project*. Fourth Edi. Little, Brown Book Group.
- De Vaus, D. A. (1996). *Surveys in Social Research*. Fourth Edi. University College of London Press.
- Denning, S. (2016). Agile's ten implementation challenges. *Strategy and Leadership*.
- Dionne, G. (2013). Risk management: History, definition, and critique. *Risk Management and Insurance Review*. Easterby-Smith, M., Thorpe, R. & Lowe, A. (2002). *Management Research: An Introduction*. Second Edi. SAGE Publications.
- Elbanna, S. (2013). Processes and Impacts of Strategic Management: Evidence From the Public Sector in the United Arab Emirates. *International Journal of Public Administration*.
- Eltawy, N. & Gallear, D. (2017). Leanness and agility: A comparative theoretical view. *Industrial Management and Data Systems*. ERM. (2004). *COSO. Enterprise Risk Management – Integrated Framework*.
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. *Statistics*.
- Flick, U. (2014). *An Introduction To Qualitative Research*. Fifth Edit. SAGE Publications Fifth Edit. SAGE Publications.
- Frege, G. (2005). *Critical Assessments of Leading Philosophers*. Edited by M. Beaney and E. H. Reck. Routledge (1790).
- Fustik, V. (2017). *THE ADVANTAGES OF AGILE METHODOLOGIES APPLIED IN THE ICT DEVELOPMENT PROJECTS*. *International Journal on Information Technologies & Security, №*.

- Gilbert, G. N. & Mulkay, M. (1984). Experiments Are the Key: Participants' Histories and Historians' Histories of Science. *Isis*.
- Gray, C. F., Larson, E. & Desai, G. (2013). *Project Management: The Managerial Process*. Sixth Edit. McGraw-Hill Education.
- Grint, K. (2000). *The Arts of Leadership*. Oxford University Press, USA.
- Gunn, R. (1989). Marxism and philosophy: A critique of critical realism. *Capital & Class*.
- Gustavsson, T. (2016). Benefits of agile project management in a non-software development context - A literature review. *Project Management Development – Practice and Perspectives: Fifth International Scientific Conference on Project Management in the Baltic Contries April 14-15, Riga, University of Latvia*.
- Haines, T. & Idemudia, Efosa C. Raisinghani, M. S. (2017). The Conceptual Model for Agile Tools and Techniques. *American Journal of Management*, vol. 17(3).
- Henriques, V. & Tanner, M. (2017). A systematic literature review of agile and maturity model research. *Interdisciplinary Journal of Information, Knowledge, and Management*.
- Hopkin, P. (2017). *Fundamentals of Risk Management Understanding, Evaluating and Implementing Effective Risk Management*. 4th Editii. KOGAN PAGE.
- Hummel, M. (2014). State-of-the-art: A systematic literature review on agile information systems development. *Proceedings of the Annual Hawaii International Conference on System Sciences*.
- Jalali, S. & Wohlin, C. (2012). Global software engineering and agile practices: A systematic review. *Journal of software: Evolution and Process*.
- Joseph, S., Beer, C., Clarke, D., Forman, A., Pickersgill, M., Swift, J., Taylor, J. & Tischler, V. (2009). Qualitative Research into Mental Health: Reflections on Epistemology. *Mental Health Review Journal*.

- Khare, S. R. & Shrivastava, R. (2015). Literature Survey on Agile Information Systems Development. *International Research Journal of Engineering and Technology (IRJET)*, vol. 02(08).
- Knight, F. (1964). *Risk, Uncertainty, and Profit*. Augustus M. Kelley.
- Kongyai, B. & Edi, E. (2011). *Adaptation of Agile Practices : A Systematic Review and Survey*. Blekinge Institute of Technology.
- Kuzel, A. (1992). 'Sampling in qualitative inquiry'. , in *Doing qualitative research*.
- Leung, W.-C. (2001). How to design a questionnaire. *BMJ*.
- Leybourne, S. A. (2009). Improvisation and agile project management: a comparative consideration. *International Journal of Managing Projects in Business*.
- Luna, A., Costa, C., Moura, H., Novaes, M. & Nascimento, C. (2010). AGILE GOVERNANCE IN INFORMATION AND COMMUNICATION TECHNOLOGIES: SHIFTING PARADIGMS. *JISTEM Journal of Information Systems and Technology Management*.
- Manole, M. & Avramescu, M. (2017). Comparative analysis of agile project management tools. *Economy Informatics*.
- Marsden, R. (1982). Industrial relations: A critique of empiricism. *Sociology*.
- Marshall MN. (1996). Sampling for qualitative research Sample size. *Family Practice*.
- May, T. (2011). *Social Research: Issues, Methods and Process*. Fourth Edi. McGraw-Hill Education (UK).
- McAvoy, J. & Sammon, D. (2005). Agile Methodology Adoption Decisions: An Innovative Approach to Teaching and Learning. *Journal of Information Systems Education*.
- McLeod, J. (1994). *Doing Counselling Research*. SAGE Publications.

- Meredith, S. & Francis, D. (2000). The TQM Magazine Journey towards agility: the agile wheel explored. *The TQM Magazine International Journal of Operations & Production Management Iss Benchmarking: An International Journal Iss*.
- Merna, T. & Al-Thani, F. F. (2008). *Corporate Risk Management*. Second Edi. Wiley.
- Moore, K. J. & Dixon, P. M. (2015). Analysis of combined experiments revisited. *Agronomy Journal*.
- Munn, P. & Drever, E. (1995). Using questionnaires in small-scale research. *Journal of Applied Social Psychology*.
- Naoum, S. G. (2012). *Dissertation research and writing for construction students, Second Edition. Dissertation Research and Writing for Construction Students, Second Edition*.
- Nerur, S., Mahapatra, R. & Mangalaraj, G. (2005). Challenges of migrating to agile methodologies. *Communications of the ACM*.
- Newell, R. (1993). 'Questionnaires', in *Researching social life*. SAGE Publications, pp. 94–115.
- Perminova, O., Gustafsson, M. & Wikström, K. (2008). Defining uncertainty in projects - a new perspective. *International Journal of Project Management*.
- PMI. (2009). *Practice Standard for Project Risk Management. Project Management Institute, Inc. (PMI)*.
- PMI. (2013). 'PMI, (2013) a guide to the project management body of knowledge (pmbok guide) (pmbok guide). 5th ed. project management institute.' , in *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*.
- PMI & AgileAlliance. (2017). *Agile Practice Guide. PMI Book*.
- Rajagopalan, S., Mathew, S. K., Rajagopalan, S. & Mathew, S. K. (2016). Choice of Agile Methodologies in Software Development Choice of Agile Methodologies

in Software Development: A Vendor Perspective. *International Technology and Information Management*.

Rajamanickam, D. (2005). Successful Project Management Using Agile Methodology. *Journal of the Quality Assurance Institute*.

Rasnacis, A. & Berzisa, S. (2016). Adaptation of Agile Project Management Methodology for Project Team. *Information Technology and Management Science*.

Saunders, Mark N.K. Thornhill, A. & Lewis, P. (2009). *Research Methods for Business Students*. Fifth Edition. Pearson Education Limited.

Schwaber, K. & Sutherland, J. (2017). The Scrum Guide: The Definitive The Rules of the Game. *Scrum.Org and ScrumInc*.

Shore, J. & Warden, S. (2008). *The Art of Agile Development*. O'Reilly Media.

Silverman, D. (2014). *Interpreting Qualitative Data*. Fifth Edit. SAGE Publications.

Smith, B. & Thomas, A. (1998). Axiology. *Routledge Encyclopedia of Philosophy*.

Smith, J. K. (1983). Quantitative Versus Qualitative Research: An Attempt to Clarify the Issue. *Educational Researcher*.

Solinski, A. & Petersen, K. (2016). Prioritizing agile benefits and limitations in relation to practice usage. *Software Quality Journal*.

Somekh, B. & Lewin, C. (2005). *Research Methods in the Social Sciences*. SAGE Publications.

Sulaiman, N., Mahrin, M. & Yusoff, R. (2016). Influential Factors on the Awareness of Agile Software Development Methodology: A Systematic Literature Review. *Journal of Internet Computing and Services*.

Sungkur, R. K. & Ramasawmy, M. (2014). Knowledge4Scrum, a novel knowledge management tool for agile distributed teams. *VINE*.

Suri, H. (2011). Purposeful sampling in qualitative research synthesis. *Qualitative Research Journal*.

Tarwani, S. & Chug, A. (2016). Agile methodologies in software maintenance: A systematic review. *Informatica (Slovenia)*.

Totten, J. (2017). Critical Success Factors for Agile Project Management in Non-Software Related Product Development Teams. *Dissertation*.