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Analysis of Scrum practices for risk treatment

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Abstract: The adoption of the Scrum framework is growing in order to increase the success rate of software development projects. However, the risk treatment in Scrum is performed implicitly. In addition, the scientific literature on this topic is scarce. This study aims to identify and analyze the risk treatment practices proposed by Scrum. The research method used is the case study with the participation of the Scrum Masters from the Instituto Nacional de Telecomunicações. The results indicate that, unlike literature, the simple integration of the Extreme Programming and Scrum is not able to reduce the projects risks and the initial risk analysis is performed in possession of the Sprint backlog. The Scrum Master has key role in the risk treatment and this treatment must be done with an emphasis on Product Backlog and during the Sprint.

Keywords: *Scrum*, risk treatment, case study.

1. Introduction

The software development projects are complex in any context and are prone to failure (BANNERMAN, 2008). The complexity of these projects makes them largely exceeding the time and budget (KAUR; SENGUPTA, 2011). The Standish Group (2013) states that the success rate of these projects is 39%.

In this scenario, the software development industry is adopting adaptive approaches instead of prescriptive approaches (WEST; GRANT, 2010). This is because prescriptive approaches are often considered heavy and slow (DE BORTOLI; RABELLO, 2006; GODINHO, 2008), while the adaptive approaches emphasize the agility of the software development process (PFLEEGER, 2009; PRESSMAN, 2010).

The agile methodologies are examples of adaptive approaches, and the Scrum framework is one of the most widely used in software development projects (MAHNIC, 2010; GARZAS; PAULK, 2013; ALHARBI; QURESHI, 2014). Scrum provides a set of best practices aimed at fast delivery of value to the customer.

However, the risk treatment, which is critical to the success of any software project (CHOWDHURY; AREFEEN, 2011), is treated implicitly in adaptive approaches (KHATRI; BAHRI; JOHRI, 2014; MORAN, 2014; NELSON; TARAN; HINOJOSA, 2008; NYFJORD; KAJKO-MATTSSON, 2007).

Nyfjord and Kajko-Mattsson (2007) conducted a comparative analysis between traditional and agile approach of Risk Management. The authors say that agile approaches do not offer risk management taxonomy and suggest its integration to the traditional Risk Management to ensure the effectiveness of risk treatment.

Furthermore, the Risk Management literature applied to software development projects using agile methodologies is scarce (HIJAZI; KHDOUR; ALARABEYYAT, 2012). The few studies of its implementation with agile methodologies do not give emphasis on the process of how the team determines priority and take actions about the risks (SMITH; PICHLER, 2005).

In this context, this article analyzes the practices proposed by Scrum for the risk treatment.

2. Literature review

2.1. The Scum framework

Scrum is defined by its creators (SCHWABER; SUTHERLAND, 2013) as a structural framework used to manage complex products that allows the integration of various processes or techniques. Farlex (2014) defines a framework as a structure to support or attach other items, that is, a skeletal support used as a base for something that is being built.

Some authors define Scrum as a methodology and not a framework. For example, Garzás and Paulk (2013) set Scrum as a project management method based on using an iterative and incremental life cycle model in the software development. On the other hand, Schwaber (2004) states that Scrum is an agile process or rather framework for agile project management. Scrum is framed as a process for project management and is not a methodology, if it were,

it would be heavy (SCHWABER, 2004). This research uses the Scrum definition as a framework, based on the definition of its founders (SCHWABER; SUTHERLAND, 2013).

The team roles, events, artifacts, and rules are Scrum components. The papers are divided into Product Owner, Development Team and Scrum Master. The Scrum teams are multifunctional and able to complete the work without relying on people outside the team. These teams are self-organized which enables them to define the best way to do the work without the need to be led by someone.

The Scrum prescribes five events, also known as ceremonies, of which have a maximum duration that can not be reduced or increased (SCHWABER; SUTHERLAND, 2013). These events are designed to enable transparency and inspection of the projects. If any event is not run, the transparency and inspection will be affected negatively (SCHWABER; SUTHERLAND, 2013).

Another Scrum component are the artifacts that are designed to maximize the information transparency. Among the artifacts, the Product Backlog can be highlighted, which is an ordered list of all items needed in the product. The Sprint Backlog is a list of Product Backlog items that should be developed at Sprint. At the end of the Sprint, another artifact is created. This increment is the sum of the Sprint Backlog items. The increase must be in usable condition and meet the definition of "Ready" created by the Scrum team.

The Scrum lifecycle provides the product monitoring and impediments identification. Some authors define the impediment as a project risk (MENEZES JUNIOR; GUSMÃO; MOURA, 2013; MARÇAL et al., 2007), while other authors state that there are differences between these two concepts (TOMANEK; JURICEK, 2015; JAKOBSEN; JOHNSON 2008; SZALVAY, 2007).

According Tomanek and Jurek (2015) and Szalvay (2007), the impediment is defined as any occurrence that prevents any member of the Scrum team to develop their work efficiently. This research uses the definition proposed by Jakobsen and Johnson (2008), as being a problem that has already occurred and that is affecting the project's progress.

In this context, risk management when used in Scrum projects enables to prevent the occurrence of impediments, implementing proactive measures to inhibit that project risks become impediments in the future (JAKOBSEN; JOHNSON, 2008).

2.2. The Risk Treatment in Scrum

The risks in software projects can be defined as a number of factors or conditions that may threat the project success (WALLACE et al., 2004). It is important to quantify the risk, assessing the probability of their occurrence and their potential impact on the project (HUANG; HAN, 2008).

According to Schwaber and Sutherland (2013), the Scrum framework employs an iterative and incremental approach to optimize the predictability and the risk control. The authors also claim that the use of Sprints also helps in Risk Management, since it limits the risk to the cost of a calendar month (SCHWABER; SUTHERLAND, 2013).

However, other authors believe that Scrum and agile methodologies in general do not suggest specific activities for Risk Management (KHATRI; BAHRI; JOHRI, 2014; MORAN, 2014; NELSON; TARAN; HINOJOSA, 2008; NYFJORD; MATTSSON, 2007) and this management in Scrum is not effective as in traditional practices (RAVI et al., 2012). For Ravi et al. (2012), Scrum provides only the risk identification practices, but do not offer a way to analyze and manage them.

Despite its importance, the literature of risk treatment in Scrum is scarce (HIJAZI; KHDOUR; ALARABEYYAT, 2012). The researches of risk treatment in agile methodologies do not emphasize the process of how the team determines the priority for the identified risks (SMITH; PICHLER, 2005). To verify these claims will be conducted a literature review.

3. Data collection

The data collection based on the ISI Web of Knowledge (HARZING, 2013), Scielo (MENEGHINI; MUGNAINI; PACKER, 2006) and Harzing's Publish or Perish (SEGALLA, 2008) databases. Table 1 shows the criteria used and the results.

On the presented results, the following criteria were defined for the articles selection:

- Articles with at least one citation on the ISI Web of Knowledge database;
- The two articles identified in the Scielo database;
- The 10 articles with the highest number of citations on the Harzing's Publish or Perish database.

The established criteria provided the identification of 20 articles, presented in the Table 2.

The 20 articles were evaluated aiming to identify risk treatment practices and activities. This process identified 14 risk treatment practices in 7 of the 20 articles analyzed. Therefore, 13 articles did not have any risk treatment practice.

However, the evaluation did not identify any activity or process to implement the risk treatment. This result converges with the literature, which claims that the Scrum framework does not provide any specific activity to treat risks (KHATRI; BAHRI; JOHRI, 2014; MORAN, 2014; NELSON; TARAN; HINOJOSA, 2008; NYFJORD; KAJKO-MATTSSON, 2007).

Table 1. Criteria and results in the three databases.

Date of Search	Search parameters		Number of articles identified		
	Filters used	Keywords	ISI *Web of Knowledge*	Scielo	Harzing´s *Publish or Perish*
15/10/2014	• The keywords were searched only in the articles titles • Only considered articles published between 2000 and 2014. • The "Articles" option has been selected for the ISI Web of Knowledge database	"Scrum", "Project", "Risk", "Management"	0	0	0
		"Scrum", "Risk", "Management"	0	0	0
		"Scrum"	18	2	Above 1,000
		TOTAL	**18**	**2**	**Above 1,000**

Table 2. Scrum articles identified.

Title	Reference	Database
A Capstone Course on Agile Software Development Using Scrum	Mahnic (2012)	ISI Web of Knowledge
A Case Study on Agile Estimating and Planning using Scrum	Mahnic (2011)	ISI Web of Knowledge
A teamwork model for understanding an agile team: A case study of a Scrum project	Moe et al. (2010)	ISI Web of Knowledge
Agile methods in European embedded software development organisations: a survey on the actual use and usefulness of Extreme Programming and Scrum	Salo and Abrahamsson (2008)	ISI Web of Knowledge
Agile project management with Scrum	Schwaber (2004)	Harzing´s Publish or Perish
Comparative Evaluation of Delfdroid whit XP and Scrum using the 4-DAT	Ernesto and Abel (2013)	Scielo
Developing software with scrum in a small cross-organizational Project	Dingsoyr et al. (2006)	ISI Web of Knowledge
Distributed scrum: Agile project management with outsourced development teams	Sutherland et al. (2007)	Harzing´s Publish or Perish
Implementation of Scrum Agile Methodology in software product project in a small technology-based company	Carvalho and Mello (2012)	Scielo
Improving agility and discipline of software development with the Scrum and CMMI	Lukasiewicz and Miler (2012)	ISI Web of Knowledge
Scaling lean & agile development: thinking and organizational tools for large-scale Scrum	Larman and Vodde (2008)	Harzing´s Publish or Perish
Scrum and XP from the Trenches	Kniberg (2007)	Harzing´s Publish or Perish
Succeeding with agile: software development using Scrum	Cohn (2010)	Harzing´s Publish or Perish
Teaching Scrum through Team-Project Work: Students' Perceptions and Teacher's Observations	Mahnic (2010)	ISI Web of Knowledge
The agile requirements refinery: Applying Scrum principles to software product management	Vlaanderen et al. (2011)	ISI Web of Knowledge
The enterprise and scrum	Schwaber (2007)	Harzing´s Publish or Perish
The scrum guide	Schwaber and Sutherland (2011)	Harzing´s Publish or Perish
The Scrum software development process for small teams	Rising and Janoff (2000)	ISI Web of Knowledge
Using Scrum in Global Software Development: A Systematic Literature Review	Hossain, Babar and Paik (2009)	Harzing´s Publish or Perish
Using Scrum to guide the execution of software process improvement in small organizations	Pino et al. (2010)	ISI Web of Knowledge

The identified practices were classified according to the definition of Scrum components and subcomponents (SCHWABER; SUTHERLAND, 2013), which are presented in Table 3.

The classification result has been validated by an expert who has over 5 years experience in Scrum, besides having the Professional Scrum Master certification (SCRUM.ORG, 2015). Table 4 presents all risk treatment practices and their respective classifications.

The 14 risk treatment practices were transferred to a questionnaire, providing the generation of 14 questions, in order to verify the agreement of Scrum practitioners with these practices. The Likert scale of 4 points was applied on each question, because this form does not allow respondents to choose a central point that can be considered as a value-neutral or no opinion (HAIR et al., 2005).

The questionnaire was submitted to a pilot test in a software development company which uses the Scrum

framework for over five years. The pilot aims to ensure that the research instrument is well structured and also allow the identification of flaws in the protocol, such as difficulties in interpreting by the respondents (FLYNN et al., 1990). It is important to mention that the pilot test did not detect opportunities for improvement or corrections in the questionnaire.

Table 3. The Scrum components and subcomponents.

Component	Subcomponent
Team	Product Owner
	Development Team
	Scrum Master
Events	Sprint
	Sprint Planning
	Daily Meeting
	Sprint Review
	Sprint Retrospective
Artifacts	Product Backlog
	Sprint Backlog
	Increment

The field research was held between 02.11.2015 and 11.13.2015 at the Instituto Nacional de Telecomunicações. The interviews were applied on-site and lasted about 30 minutes each. The interviewees were Scrum Master with over three years experience in Scrum and they were asked to assign a value between 0 and 3 for each risk treatment practice.

After the data collection, the Cronbach's alpha (BRYMAN; BELL, 2007) was calculated to assess the internal consistency of the questionnaire. The Cronbach's alpha can vary between 0 and 1, and the reliability of the data and constructs will be higher the closer it is to 1 (BRYMAN; BELL, 2007).

Segundo Bryman and Bell (2007), o valor mínimo aceitável para o Alpha de Cronbach é de 0,8, enquanto que outros autores determinam o valor de 0,7 como sendo o mínimo (HAIR et al., 1995; SCHUTTE et al., 2000; HAIR JUNIOR et al., 2005).

According to Bryman and Bell (2007), the minimum acceptable value for Cronbach's alpha is 0.8, while other authors determine the value of 0.7 as the minimum

Table 4. The risk treatment practices and their classification.

Nº	Risk treatment practices	Classification	
		Component	Subcomponent
1	The initial risk analysis is performed in possession of the Product Backlog (CARVALHO; MELLO, 2012).	Artefacts	Product Backlog
2	The prioritization of the Product Backlog by the Product Owner provides risk reduction (SCHWABER, 2007).	Artefacts	Product Backlog
3	The high-risk items of the Product Backlog should be classified as high priority to be understood and resolved in the beginning of the Project (SCHWABER, 2007).	Artefacts	Product Backlog
4	During the planning phase, the risks must be identified using techniques such as brainstorming (LUKASIEWICZ; MILLER, 2012).	Events	Sprint Planning
5	The risk treatment approach should be among the objectives of the Scrum meetings (RISING; JANOFF, 2000).	Events	Sprint Planning, Daily Meeting, Sprint Review, Sprint Retrospective
6	The performance of daily meetings reduces project risks (CARVALHO; MELLO, 2012).	Events	Daily Meeting
7	The project information are often presented to the customer and this enables the optimization of risk strategies (SCHWABER, 2007).	Events	Daily Meeting, Sprint Review
8	Allowing the work exceeds the limit Sprint increases the project risk (SUTHERLAND et al., 2007).	Events	Sprint
9	The customer feedback to the development team at the end of each Sprint reduces the project risks (CARVALHO; MELLO, 2012).	Events	Sprint
10	Dealing with the risky items in early sprints provides time to recover if technical difficulties arise (RISING; JANOFF, 2000).	Events	Sprint
11	The Scrum Master should work constantly to reduce risk through: incremental delivery, rapid response to the development obstacles, continuous monitoring of the increment delivery (RISING; JANOFF, 2000).	Events and Roles	Product Backlog Scrum Master
12	The Product Owner reduces some of the major project risks when performs the Product Backlog prioritization (LARMAN; VODDE, 2008).	Events and Roles	Product Backlog Product Owner
13	The integration of Scrum with Extreme Programming reduces project risks (SUTHERLAND et al., 2007).	No classification	No classification
14	The Backlog Impediments provides risk mitigation (CARVALHO; MELLO, 2012).	No classification	No classification

(HAIR et al., 1995; SCHUTTE et al., 2000; HAIR JUNIOR et al., 2005).

The Cronbach's alpha coefficient obtained for this questionnaire was 0.9975, which means is within acceptable values and that the scales used have acceptable internal consistency.

4. Results analysis

The results show that the bibliographic review was identified in 40% of the analyzed articles. The case study (YIN, 2009) was the second most common methodology, being present in 30% of analyzed articles, as shown in Figure 1.

It is observed in Figure 2 that 56% of the identified practices are related to the events, while 19% are related to the artifacts defined by Scrum.

The Figure 3 shows that 28% of the identified practices are related to the Product Backlog, while the Sprint and the Daily Meeting are related to the practices 17%, respectively.

It can be observed that the Product Backlog is the Scrum artifact most cited by risk treatment practices. For Sutherland and Schwaber (2011), the Product Backlog is prioritized in order to maximize ROI (Return of Investment) or to reduce some of the major project risks.

Regarding Scrum events, it was found that Sprint and Daily Meeting are the events most frequently cited by the practices. This result can be explained by the statement of the authors Schwaber and Sutherland (2013), which define the Sprint as responsible for limiting the risk to the cost of a calendar month, bringing benefits to the risk. The authors also argue that the Sprint provides an iterative and incremental approach that improves the risk predictability and control. Furthermore, the risk identification occurs iteratively during daily meetings (MARÇAL et al., 2007).

It was also observed that the Scrum roles most cited by the risk treatment practices were the Scrum Master and Product Owner. This result indicates convergence with the opinion of some authors, who claim that the Scrum Master is responsible for the risk treatment processes (KTATA; LÉVESQUE, 2010; QURESHI; ALBARQI, 2015).

The articles analyzed did not present any specific activity for the risk treatment performance. Furthermore, none of the articles were focused on risk treatment.

The interview results are shown in Table 5.

It is observed that presence of risk mitigation in the objectives of Scrum meetings is one of the practices with the highest average score. This means that the respondents agreed with this practice. This result converges with the opinion of other authors who claim that Scrum meetings have potential for the risk treatment (MARÇAL et al., 2007; FELKER; SLAMOVA; DAVIS, 2012; AHOLA et al., 2014).

The other practice which had the highest result is related to the use of Backlog Impediments to provide risk mitigation. It is important to mention that there are different impediments definitions where there are authors that define the impediment as a project risk (MENEZES JUNIOR; GUSMÃO; MOURA, 2013; MARÇAL et al., 2007), while other authors state that there are differences between these two concepts (TOMANEK; JURICEK, 2015; JAKOBSEN; JOHNSON, 2008; SZALVAY, 2007).

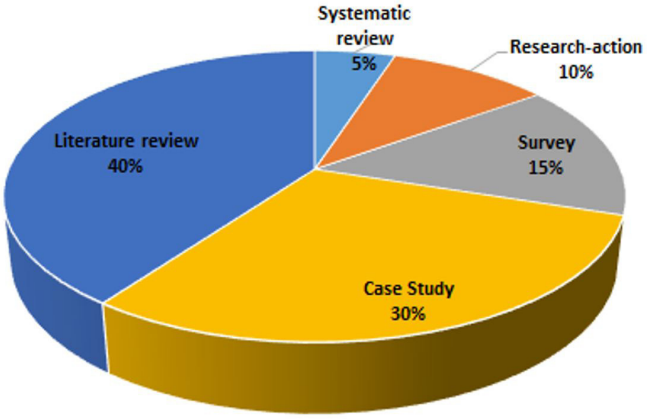

Figure 1. Classification of the articles according to research methodology.

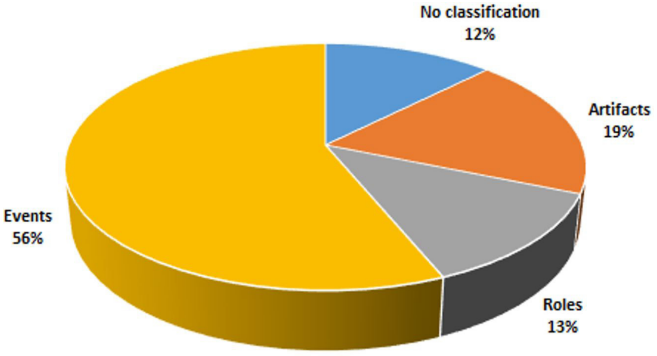

Figure 2. Classification of the articles according to component.

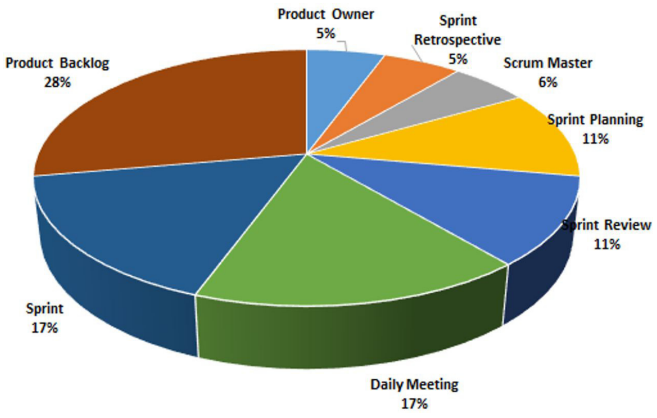

Figure 3. Classification of the articles according to subcomponent.

Table 5. The interview results.

Nº	Risk treatment practices	Classification		Scrum Masters					Mean
		Component	Subcomponent	1	2	3	4	5	
5	The risk treatment approach should be among the objectives of the Scrum meetings (RISING; JANOFF, 2000).	Events	Sprint Planning, Daily Meeting, Sprint Review, Sprint Retrospective	3	3	3	3	3	**3**
14	The Backlog Impediments provides risk mitigation (CARVALHO; MELLO, 2012).	No classification	No classification	3	3	3	3	3	**3**
3	The high-risk items of the Product Backlog should be classified as high priority to be understood and resolved in the beginning of the Project (SCHWABER, 2007).	Artefacts	Product Backlog	3	3	2	3	3	**2.8**
2	The prioritization of the Product Backlog by the Product Owner provides risk reduction (SCHWABER, 2007).	Artefacts	Product Backlog	2	3	2	3	3	**2.6**
4	During the planning phase, the risks must be identified using techniques such as brainstorming (LUKASIEWICZ; MILLER, 2012).	Events	Sprint Planning	2	3	2	3	3	**2.6**
7	The project information are often presented to the customer and this enables the optimization of risk strategies (SCHWABER, 2007).	Events	Daily Meeting, Sprint Review	3	3	2	2	3	**2.6**
8	Allowing the work exceeds the limit Sprint increases the project risk (SUTHERLAND et al., 2007).	Events	Sprint	2	3	2	3	3	**2.6**
9	The customer feedback to the development team at the end of each Sprint reduces the project risks (CARVALHO; MELLO, 2012).	Events	Sprint	2	3	2	3	3	**2.6**
10	Dealing with the risky items in early sprints provides time to recover if technical difficulties arise (RISING; JANOFF, 2000).	Events	Sprint	2	3	2	3	3	**2.6**
11	The Scrum Master should work constantly to reduce risk through: incremental delivery, rapid response to the development obstacles, continuous monitoring of the increment delivery (RISING; JANOFF, 2000).	Events and Roles	Product Backlog, Scrum Master	2	3	2	3	3	**2.6**
12	The Product Owner reduces some of the major project risks when performs the Product Backlog prioritization (LARMAN; VODDE, 2008).	Events and Roles	Product Backlog, Product Owner	2	3	2	3	3	**2.6**
6	The performance of daily meetings reduces project risks (CARVALHO; MELLO, 2012).	Events	Daily Meeting	2	2	3	2	3	**2.4**
1	The initial risk analysis is performed in possession of the Product Backlog (CARVALHO; MELLO, 2012).	Artefacts	Product Backlog	1	1	1	0	0	**0.6**
13	The integration of Scrum with Extreme Programming reduces project risks (SUTHERLAND et al., 2007).	No classification	No classification	0	1	1	0	0	**0.4**

The definition of impediment used by the respondents is that proposed by Jakobsen and Johnson (2008), as a problem that has already occurred and is impacting on the project's progress, making thus distinction between risk and impediment.

On the other hand, the respondents in general disagreed with the practice related to risk reduction promoted by the integration between Extreme Programming (XP) and Scrum. They believe that only the integration between these two agile methodologies do not provide risk reduction.

Furthermore, the results indicate disagreement of the respondents with the practice related to the initial risk analysis be performed with the product backlog. They claim that this process is performed in possession of the Sprint backlog during the Sprint Planning Meeting.

5. Conclusions

Despite the risk treatment be fundamental to the projects success, it is not widely used and the Scrum framework do not provide specific activities for its achievement. Moreover, the scientific literature about risk treatment in Scrum is incipient.

This study identified 14 practices of risk treatment in Scrum, which most of them are related to the Product Backlog, Sprint and daily meeting. This result indicates that these subcomponents have greater influence in the risk treatment.

The practice related to the presence of risk mitigation in the objectives of Scrum meetings is one of the most important in the respondents opinion, converging with Scrum literature.

Furthermore, in the respondents opinion, the use of the Impediments Backlog provides risk mitigation. This artifact is not described in the Scrum Guide (SCHWABER; SUTHERLAND, 2013), but is commonly used in Scrum projects (TOMANEK; JURICEK, 2015, JAKOBSEN; JOHNSON, 2008; SZALVAY, 2007).

However, this study identified two risk treatment practices with incompatible results with the Scrum literature. The respondents claim that the simple integration between Extreme Programming and Scrum is not able to reduce the project risks and the initial risk analysis is performed in possession of the Sprint Backlog instead of the Product Backlog.

For future researches, it is suggested to enhance the search string in order to identify other articles with risk treatment practices. In addition, it is recommended to identify the artifacts, ceremonies, rules and roles of Scrum which:

- Are affected by the risks of higher exposure (higher probability and impact);
- Have greater potential for prioritizing the risk treatment;
- Maximize the treatment of the highest exposure risks (greater likelihood and impact).

It is also suggested that further studies be carried out to identify which techniques and tools are most appropriate for risk treatment in Scrum projects.

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