W4RM: A prescriptive framework based on a wiki to support collaborative risk management in information technology projects

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Abstract:
Despite the positive influence of risk management in Information Technology (IT) project results, many project managers are not managing risks or are managing them partially. To enhance risk management, collaborative project management has gained attention in recent years with the introduction of Web 2.0 tools. Project managers have used such tools to facilitate open communication and distribution of activities. This research introduces a prescriptive framework (W4RM – Wiki for Risk Management) based on a wiki to support collaborative risk management in IT projects. An exploratory focus group was set up and a series of interviews with practitioners was conducted to explore how a wiki can support risk management in IT projects. Findings show that project managers are facing difficulties managing risks and are the only ones responsible for identifying, registering and monitoring risks. By implementing a collaborative tool, managers can disseminate a collaboration culture and participate in risk management processes. This sense of collaboration may be used to keep the community identifying new risks, relating these risks to one or more projects, and facilitating continuous risk management. Practitioners can also adopt W4RM as a tool to support communication regarding risks status to be established for internal team stakeholders.

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1. Introduction

Software, as a tool to manage a project, is widely used by companies. The proper use of these tools, associated with a methodology, can influence project results positively [1]. Web 2.0 tools ease communication and collaboration between people, creating networks of direct communication for all users in the same community, allowing the flow of ideas and knowledge with efficient generation, dissemination, sharing and refining of information [2, 3]. Although the use of the internet and emails have been the major means of communication between teams, the use of applications and Web 2.0 tools have emerged in the last few years and present a new opportunity to manage Information Technology (IT) projects successfully [4, 5].

One of these Web 2.0 tools is the wiki, which is being adopted by companies to be used in different segments, enabling interactivity and communication between internal and external teams [6]. In Project Management (PM), wikis have been used as a tool to organize project information and help project managers create and share information with project teams and stakeholders [7-9]. Wikis are a useful tool that can be adopted by project managers for knowledge dissemination and project documentation [3].

Not only project managers, but also all project stakeholders are being helped by wiki usage in such different activities as document system development, managing document versions and report activities [10]. Considering that wikis bring with them a change of paradigm (collaboration, active participation by the project team, transparency and co-responsibility) to deal with risks, this research proposes the use of wiki pages to manage risks in IT projects. Wikis confront the users with unused ways of working with IT systems [3]. Although proposed solutions that make use of sophisticated methods without ensuring applicability might be useless in practice, researchers mention problems in risk management that *can* be supported by a wiki tool, but a framework for this proposal is absent in the literature.

Some of these problems include risk identification, when not all of the team is involved [11]; risk communication, when stakeholders lack information regarding risks [12]; and risk control, when the team is not informed of risk status and not updated with new information, or new risks [13]. To deal with these issues, this study intends to find answers to the following research question: How can a wiki support risk management in IT projects? To answer this question, this research will: 1) Verify risk management gaps reported in the literature and show how wiki pages can help with that; 2) Propose a framework based on a wiki to support risk management; and 3) Validate with experts the proposed framework and viability of implementation for risk management processes.

This paper is organized as follow. Section 2, the background of difficulties in project management is outlined and how the main wiki characteristics may help on that. In section 3 we present research methodology. The results are presented in section 4. Section 5 contains theoretical and practical contributions of this paper. Finally in section 6, we present our conclusions.

2. Background

2.1 Risk management in IT projects

IT projects are exposed to a greater number of risks due to their technological dependence. Monitoring and mitigating risks related to technology dependency can contribute to project success [14]. Although there are different definitions of risk management in projects, common aspects emerge among them, such as the description of main activities emphasizing the execution of these activities for successful risk management. References such as, Project Management Institute [15], Kerzner [16] and Office of Government Commerce [17], have their own list of activities that they present as important to be done. Some activities like risk identification, risk analysis and risk control, are present in all definitions as major activities.

Analyzing risk management and PM guides has allowed the identification of common steps in managing risks, such as: *Identification* - despite different names and terminology, all guides define a step to perform this action; *Assessment* - this step is also identified in all guides, but in different ways. Some of them suggest carrying out assessment in one step

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and others in two steps; ***Response Strategy*** - the guides propose response strategies according to project strategy, budget, priorities and prioritization of risks; ***Communication*** - the guides suggest effective communication by establishing recurrence and periodicity for the internal team and stakeholders; and ***Control*** - this phase is presented in all guides, yet in some, beginning after a response strategy has been created and communicated.

Several studies have positively related risk management and project success [18-21], but this relation is not consensual among researchers. While some of them point out that a relationship between risk management and project success could not be found [22], others report that despite project managers agreeing that risk management can have a positive influence on project success, they do not apply risk management to their projects [23]. Although this nonconsensual evidence of the positive relation between risk management and project success, risk management is a critical activity that should be stimulated by project managers and done by everyone involved in the project.

The risk management process will require the action of project members during the entire project cycle, not only remediating occurred events, but preventively acting to fix negative events before they occur [24]. A continuous and iterative process needs to be performed at regular intervals to analyze, plan, track and fix risk events and consequences [13]. In order for a project team to achieve a successful coordination of all these activities, it is essential that project managers pay attention to risk management and create a recurrent agenda with all the team [25]. The coordination required regards not only the internal team, but additional stakeholders as well [26]. Complex and innovative projects are influenced by inputs from other teams and external partners [25]. Therefore, planning the right coordination practice is important, due to the influence on information sharing between teams and the generation of outcomes [25].

An additional challenge for project managers to implement and execute risk management is the risk aversion among stakeholders. Sometimes project managers avoid talking about risks with stakeholders in order not to create a disturbing project environment, and just act on the consequences of negative events, but neither identifies, nor manages them as a risk [27]. Institutional pressures from sponsors and executives to get the project done quickly force project managers to deem process risk identification unnecessary, because recurrent plan and documentation activities do not fit unrealistic deadlines [24].

Project control requires a well-planned risk management, conducted by the project manager, and executed by the project team to avoid 'firefighting' activities, rather than proactively managing and eliminating potential risk threats [24]. After risk identification and assessment, new threats are not identified while the project is executed. Even when formal changes to the project occur, the risks are not reassessed and revaluated [12]. The control of risks is a challenge for project managers. Though conducting some degree of risk assessment and classification, risks are not managed continuously, turning risk management activities into a reactive process only [22]. Risk factors should be dynamically monitored and tracked during all the project cycle [13].

By reviewing literature, we identify a positive relation between risk management and project success. At the same time, we identify risk management issues or even the option not to manage risks. Once the project manager decides to manage risks, the use of an appropriate tool can help him/her in the risk management processes and improve communication between the project team and stakeholders [16].

2.2 Social media and wiki

The introduction of Web 2.0 tools in project management facilitates the deployment of the Project Management 2.0 (PM 2.0) concept. From an IT perspective, it is possible to define PM 2.0 using the formula: (PM 2.0 = PM 1.0 + distributed collaboration), where PM 1.0 is the traditional project management, and distributed collaboration is guided by open communication, which thrives on collective intelligence to support decision makers [28].

The use of Web 2.0 tools is gradually increasing and gaining acceptance in organizations, evidenced by the increasing use of the term Enterprise 2.0. The term Enterprise 2.0 refers to the use of Web 2.0 tools in organizations. The use of collaborative and interactive Web 2.0 concepts and technology has great potential for flexible integration and ad-hoc information exchange among collaborators [3]. These tools enable organizations to communicate interactively and

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engage with their supply chain and provide their customers with a sense of empowerment. Communication tools support social bonding across any distance, creating a virtual work environment and creating virtual colleagues [29].

Establishing a sense of unity to create a team and stimulate the ability of individuals to collaborate and work effectively as a team is a challenge for managers [30]. As face-to-face communication is not always possible, communication technology is crucial to develop trust within distributed project teams [30]. In order to increase the probability of success to establish a team and enhance the intensity of collaboration and trust in projects, communication and participation need to be addressed through an integrated project methodology [3]. Web 2.0 concepts and technologies can be used to promote participation and open a corporate dialog, stimulating participation and cooperatively working on the identification, rating, and commenting of issues, creating businesses discussions instead of only consuming content [3,31].

Enterprise Collaboration Systems are software systems that combine enterprise social software like wiki, with traditional groupware components, like e-mail, databases, libraries to support organizations specifically in internal business communication, collaboration, and content and knowledge sharing activities [32]. Enterprise Collaboration Systems support the collaborative work of employees, comprising all areas of collaboration such as information and content sharing, communication, cooperation and coordination [33]. These large volumes of social content are comprised of a wide variety of documents (e.g. wiki entries), many of which contain important business information that requires systematic management [34]. Rather than functioning as a channel of communication delivery only, Enterprise Collaboration Systems provide a platform upon which social interaction can occur [34].

Wiki applications have high potential to facilitate knowledge creation, sharing, use and integration. The use of wikis is increasing in different contexts, such as education, research, business, government and the public domain. It enables a collaborative environment, permitting volunteers and groups to create and edit documents incrementally [35]. One page of wiki may store information in different formats (e.g. text, links, images and videos), to collaboratively capture and share business information and knowledge [34]. Various features characterize Wiki technology including interlinking, collaborative edition and preview. There are a number of other features related to wiki, covering such aspects as structure, syntax, security and personalization [36]. The features of Wikis have made it a unique philosophy regarding knowledge sharing. Unlike other Web 2.0 tools, which tend to focus on sharing and broadcasting individual opinions, wikis focus more on consensus and collaborative understanding of contexts.

An advantage of using Wikis is the feature that allows tracking and revisions. Malicious attempts to misinform can be quickly revised or reverted to the previous version. The edit history can be used by the administration to identify the content and users that created it, preventing anonymous collaboration and discouraging the creation of content that is not aligned with the organization's policy [37]. Wikis stimulate collaboration between companies; with asynchronous collaboration, the natural flow of information allows the spreading of knowledge construction. This will benefit organizations that are expanding their business, developing a collaborative exchange of information between companies in different regions [38]. In addition, knowledge content from one company can be incorporated by another without the need to handle staff allocation [38]. Wikis are useful for knowledge dissemination and project documentation, they confront the users with unused ways of working with IT systems [3].

Comparing the literature about threats as difficulties in managing risks in projects with wiki tool characteristics makes it possible to relate them. Wiki tools can enhance risk management by applying some important steps recommended in risk management guides, or by supporting risk management gaps. Table 1 shows risk management issues, difficulties or recommendations and wiki characteristics that can help in risk management issues.

Although some project managers identify and register risks, the problems and difficulties controlling them include poorly managed identified risks and lack of a tool to help constant monitoring [12]. Wikis enable discussion between their users and can help to organize and track information, transforming information collected into a center of discussions [6]. The ability to track information allows the project manager to keep risk information up to date and shared with all the team and with stakeholders.

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Table 1. Risk Management issues and Wikis characteristics.

Risk Management Issues/ Difficulties/ Recommendations	Author(s)	Wiki Characteristics	Author(s)
Risk should be identified by different levels of an organization	[13, 15]	Wikis are used to gather and disseminate information from/to different levels in organizations.	[3,37]
Risk can occur due to lack of information.	[15]	Web 2.0 tool enables the gathering of information from many points of view	[39]
Risk identification and assessment are important steps for successful risk management	[15, 40]	Wikis allow the gathering of information from the project team, stakeholders and project committee.	[28]
Establish recurrent communication for internal team and stakeholders	[15,30 ,40]	Wiki applied to projects allows the project manager to share information with the project team and stakeholders.	[41]
Some PM tend to ignore risks when they perceive that they disturb the project environment.	[24,27]	Wiki's collaborative nature encourages negotiation and discussion and aids in achieving consensus	[4]
Project manager's perception of self-efficacy can interfere with risk perception	[42]	Implementation of wikis stimulates the culture of collaboration	[6]
There are problems and difficulties in controlling identified risks	[12,13,22]	Wiki users can help to organize and track information.	[34]

3. Method

By adopting interpretivism, we aim to seek an in-depth and context-specific understanding of lived or inner experience of PM practitioners. Figure 1 shows the research workflow adopted, and each square represents a different step.
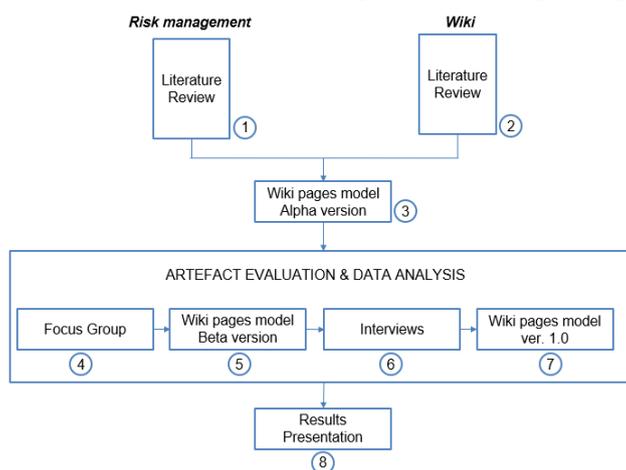

Figure 1. Research Workflow.

The first and second steps of this research were related to the literature review presented in section 2. Step 1 was the literature review on risk management in projects, and started with a search in scientific databases, such as ScienceDirect, Scopus, Wiley and Emerald Insight. The search on each database started with a query: 'risk

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management' and 'project management', reading the abstracts and selecting papers for detailed analysis according to their assumptions. The criteria for selection were papers with risk management definition in IT projects or papers presenting difficulties with risk management in projects.

In step 2, we conducted searches on the same databases of step 1. The first query was: "web 2.0" and "definition", the second query was: "wiki" and "organization" or "company", and the third query was: "wiki" and "project". The papers returned on the results had their abstracts analyzed and if the content was aligned with the research assumption, with positive or negative aspects, the paper was downloaded for a detailed reading and then cited, if used, in the literature review.

According to the literature review, we developed an alpha version of W4RM to be presented to participants in the focus group in step 3. Step 4 was an exploratory focus group of IT project managers. This focus group was directed to explore the project manager's experience with risk management in past projects, their experience with risk management tools and the success or not of this execution. The research looked for opinions about W4RM, identifying strengths, weaknesses and functionalities to be added, changed or deleted. The focus group had seven participants and one of the researchers as moderator. All participants are experienced IT project managers, with three to 23 years acting as project managers, and ages 36 to 53. The focus group was used to explore project manager experiences in managing risks, encourage discussions among participants about best practices, difficulties and recommended steps to be taken by project managers.

To stimulate interactions, we structured the focus group protocol to investigate four main topics. The first topic was about the difficulties that managers are facing in managing risks, the second was how they execute the risk management process, the third was about how familiar they are with web 2.0 tools, and the fourth aimed to gather input about the framework in the alpha version. In the first part of the section, focus group participants talked at length about the barriers they are facing, such as groups of resistance in their companies. The difficulties cited by two or more participants were grouped into five groups of coding. Appendix A shows the topics discussed on focus group meeting.

Based on the results of the focus group, we built the beta version of the wiki pages framework in step 5. This beta version was developed adding the changing characteristics identified as important by the focus group. The size and quantity of changes for this version were not pre-defined at this time, due to the characteristic of qualitative research, and it was expected that there would be an interaction between participants, with discussions, agreements and disagreements regarding the framework. The researchers were responsible for defining what suggestions would or would not be adopted.

In step 6, for the individual interviews, the number of interviews was not pre-defined and new interviews were held until data saturation. The total of interviews was 12; the criteria for choosing participants were project managers with risk management experience, and Portuguese or English speakers. In order to include a foreign point of view, the researcher invited two people from the USA and one person from Mexico to participate and contribute with their perspective. Regarding the industry sector, this research contains respondents from four different industries: Telecoms (1), Financial (4), Retail (2) and IT (5). Adding participants from multiple industry sectors can avoid any bias from a sole sector.

All the interviews were done via Skype and recorded using MP3 Skype recorder. We transcribed the interviews using the Express Scribe Transcription software. The average time for each interview was 30 minutes. Transcriptions were from five to eight pages each, generating 85 pages of transcription to be analyzed. We used MAXQDA and Excel to analyze the results. MAXQDA use is part of the analysis to encode the transcriptions and find repetitions and groups of citation. Excel was used to group and categorize data. Appendix B shows the topics and questions of the interviews.

We generated the W4RM framework (Figure 2) based upon literature review, focus group and individual interviews in step 7. The next section presents and discusses W4RM. Step 8 was the development and the presentation of the study in this article.

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4. Findings

To present the results, this section follows the sequence described in the research design. The content analysis was executed twice, the first to analyze the focus group and the second to analyze the interviews. As a result, researchers were able to develop a more mature framework based upon data analysis to be described in this section. Figure 2 shows the Alpha version of the W4RM, which is the artifact developed in this research.

Figure 2 contains three delimited sections, External Access, Wiki Pages and PM tools integration. The Wiki Pages section is the core of the framework, containing all the pages that will be accessed by the collaborators. These pages will be used to register RM methodology defined by the company, risks registered, discussion forums to be used and moderated by the community, project information that can be linked with risks and discussion threads. Tutorial pages are stored to help new users become familiar with the use of wiki and with the framework. Other sections are used to consume data from Wiki Pages. External access is proposed to feed information to databases and some monitoring tools like RSS. PM tools integration aims to feed risk information to any other database used by project managers or Project Management Office (PMO) to integrate project information.
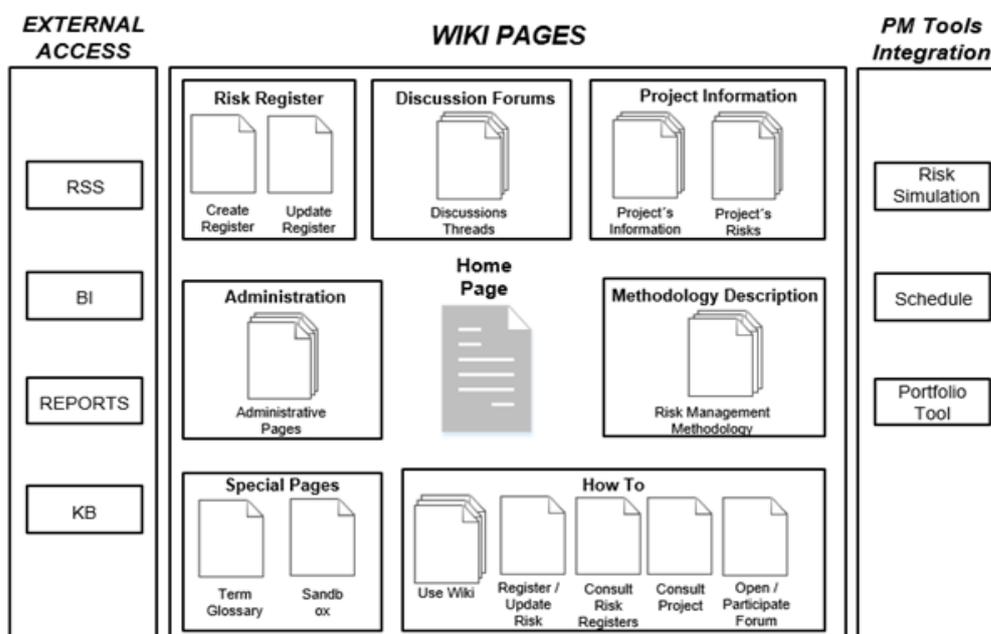

Figure 2. The Wiki for Risk Management (W4RM) Framework.

4.1 Exploratory focus group analysis

In the focus group, we aimed to understand how experienced IT project managers are managing risks. They were encouraged to talk about how they deal with risks in real life and not how they should act according to risk management standards or best practices guides. During the interview, when a participant mentioned some difficulties or some activity that he/she does, but assumed that it is not how it should be done, the mediator encouraged the other participants to say if they do or do not behave the same way.

In the first part of the section, focus group participants talked at length about the barriers they are facing, such as groups of resistance in their companies. The difficulties cited by two or more participants were grouped into five groups of coding (GC).

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GC1: Lack of feedback: Difficulty in receiving feedback from the project team, stakeholders and/or sponsor was cited by all participants

(FG05): I can meet with the project team and list risks. However, it's impossible to receive any feedback about the risk status.

(FG07): At the beginning of the project, the team accepts collaborating with risks, but receiving updates is not easy during the execution phase.

GC2: No sponsorship support: When project managers try to present some risks in the project to the sponsor, the sponsors do not usually want to talk about this issue.

(FG03) Some sponsors in my projects just refuse to talk about risks. The term risk just scares them.

GC3: Lack of Contingency Costs: Contingency costs are connected with the difficulty described as no sponsorship support. Sponsors classify any funds for risk contingency as a waste of money, assuming that the project manager and team members need to prevent any risk event without any extra money.

(FG07): After finishing the project plan with the team, I made a presentation to the sponsor explaining the risk and requesting a contingency budget. The sponsor said that I was increasing project costs before starting it, and would not approve any extra cost.

GC4: Reduction of confidence in project manager: One important fact that can stop a project manager from talking about risks is their image in front of the others. Participants said that when they are trying to talk about risks in projects, sometimes this conversation can be identified as a lack of competence on the part of the project manager or an attempt to justify future project delays.

(FG01) Once I did risk identification with a large impact on the project. I requested a meeting with the team to talk about alternatives, but during the meeting, one person said that I was being pessimistic talking about a risk like that. Some team members agreed with him, and as a result, I just ignored that risk.

GC5: Not managing risks for all projects: The option to manage a risk or not is in the hands of the project manager. Participants did not manage risks for all projects. Some participants have their own policy to decide to use risk management or not. They reported that due to difficulties in talking about risks, they avoid this type of discussion in minor projects. In this kind of project, some participants adopt a pre-defined risk list and others just ignore the risks.

(FG07): My decision is based upon project costs and innovation. For projects with minor costs and with known technology, I prefer not to manage risks.

(Moderator) Why do you prefer to ignore the risks?

(FG07): The difficulty in talking about risks is sometimes so great that dealing with the problem when it occurs is better than trying to manage risks.

The second section of the focus group aimed at finding how project managers execute risk management activities. The first question was an open question for project managers to describe what activities they execute and how. Comparing this with the literature review, it was possible to observe that the project managers are carrying out the steps found in the literature. However, none of the participants is taking all the recommended steps in the standard guides. The steps are adopted partially without any particular rule to define which step to take or ignore. Participants who mentioned using standards partially cited PMBOK® from PMI and ASAP from SAP.

After obtaining spontaneous opinions about risk management activities done by participants, the moderator started a discussion about what the state of the art should be for risk management processes in their opinion. The reason for including this topic is to find out what the most important actions and behavior expected by project managers are for the entire company, including the project managers, themselves if they are conducting risk management in a proper way. The opinions were centered on collaborative actions; project managers expect a process not focused only on their role; they expect collaboration from all the team, giving proactive input about existing risks and identifying new risks.

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(FG06): After finishing the risk management plan, it would be perfect to see information being disseminated by the whole team. In this case, the project manager will have a helper role, acting on questions about the process, getting approval from the management team and obtaining contingency funds.

(FG03): It would be great if we had input from the team right after any new risk is identified.

The last section of the focus group was focused on analyzing and discussing the artifact proposed in this research. This section started with a detailed presentation of the framework in the development version. The mediator presented the artifact as an existent artifact developed by another researcher in the past, which this research would be planning to adopt, and requested some input concerning their opinions analyzing this framework.

Regarding how this framework could help them to manage risks, one of the main ideas discussed by participants was about disseminating knowledge. According to participants, this tool can capture specialists' opinions and be available to everyone in the company. This framework can be used to stimulate participation. The PMO can encourage interactions by keeping a repository of the adopters and by showing how the collaboration supported the project.

One important aspect discussed by participants was how this framework could help create a corporate risk management culture. To the participants, this could not be done just with the framework implementation. The project should be a risk management implementation process using this framework as the tool to support the defined process. From this point of view, the PMO should be in charge of the project, starting the risk management process with directors and managers after obtaining support from them for the process. The tool should be ready to be implemented.

Another aspect debated by participants was the role of the project manager when the framework is adopted. Participants agreed that if the project manager's role is changed, the risk management process will become a collaborative process, permitting everyone on the team to be the driver for any risk. This change can diminish conflicts between the project manager and team, and the project manager can be a mediator in risks discussion and not the driver.

Based upon the input of the participants, a new version of the framework was developed. For this version, the external access layer presented in Figure 2 was introduced. Comparing the version before and after the focus group, no section was deleted for the new version and just a new layer was added to allow integration with external tools.

4.2 Interview analysis

The interview protocol was created to gather experience in implementing and managing the risk management process of twelve experts. The respondents were encouraged during the interviews to talk about their experience, about what, in their opinion, had contributed or not to a successful risk management process implementation and project risk management activities. The goal of the interviews was to understand risk management in real life, gathering points of view from project managers and their experience in projects. After explaining the objective of the interview to the respondent, and getting information about the respondent's profile, the interview was structured in four sections with a specific and complementary goal for each section.

The first section of the interviews aimed at an in-depth conversation about risk management in real life, proposing discussions about what worked or not for respondents while they were managing their projects. Five of the respondents had experience implementing the risk management process. Three of them had participated in the implementation, collaborating in the implementation in the role of counselor, giving opinions about what would work or not and feedback on the application of the process in projects. Two of them had experience as the project manager in charge of the risk management implementation process.

Analyzing the transcription of the answers regarding the risk management process, some of the recurring words cited by respondents were related to culture, barrier, resistance and the project manager. All the respondents with experience in the risk management implementation process cited these words in different contexts, but in all of the contexts, these words were cited with relevance to the process. For successful implementation, according to respondents, the PMO or any other department in charge of the implementation cannot neglect these aspects.

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Respondents identified different types of barriers. All of them described that they found initial support inside their companies when the implementation process started, but discussions particularly about risk management in specific projects suffered resistance. One of the respondents said that his team was very uncomfortable creating a list of risks in the project and communicating this to the CIO (Chief Information Officer).

(E09): To discuss risks, I sent an invitation for a meeting with all the team. When we started a brainstorming session to identify potential risks, one of the participants said that he was uncomfortable writing a specific risk and reporting it to the CIO.

The corporate culture was an important aspect cited by respondents. To implement and execute risk management, it is necessary to identify how the company deals with risks. For this identification, it is important to analyze how the word risk can affect employees. Four of the participants identified their companies as not familiar with risk discussions. Although risk is intrinsic in business, it is not discussed.

We asked respondents for their opinion about what is important for a successful risk management process. Some of the facts related to previous questions were repeated, for example, cultural aspects and a well-defined project manager role. New factors were described by respondents, such as training for project teams, an adequate tool to support the process, collaboration of the project team and implementation of the PM methodology. These factors were cited by a significant part of the respondents. Therefore, the researcher coded them as an important group of critical success factors. Some factors cited were the creation of a PMO, project manager hiring, the creation of a risk management community and a risk management fund to be used by all corporate projects.

Corporate risk management training is one of the most important critical success factors for respondents. In their opinion, employees do not have a clear understanding of what risk is. Without a clear concept of risk, these are not prepared to collaborate with a risk management process. There is a need for corporate training, starting from the basic concepts about what risk is, what an event that may cause risk is, to the techniques to identify risks and risk response strategies.

The second section of the interview aims to understand the collaboration among all employees at the respondent's companies and what needs to be improved in this process. According to respondents, project managers are in charge of all activities, while others collaborate when asked by the project manager and there are employees that do not accept cooperating with risks. Due to this scenario, risk management is restricted by project manager bias. If he/she feels that the project has a low risk, the risk management process can be neglected.

After process implementation, training or meetings to establish and communicate the importance of risk management and collaboration from team members increases, but after some time, this participation diminishes. Maintaining a spirit of collaboration regarding risk management in team members is a huge challenge. Respondents described different examples of how difficult this is for different reasons, and in their opinion, sometimes with team members' excuses for not participating.

(E02): Keeping the team collaborating means keeping the company collaborating. Everyone should be working on that, the steering committee should discuss risks for the whole project and give support to project management and encourage the project team.

The third section of the interview was about an adequate tool for risk management, and the importance of the tool to support the risk management process. According to the respondents, a tool will help the project to gather the information needed, communicate with the project team and with stakeholders. An efficient tool will keep risk registers available for everyone that needs this information, and will be used as a knowledge base for future projects.

Although the respondents agree that a tool is important to the process, many of them, when asked to answer, emphasized the importance of team collaboration. A tool will help project managers to manage risk, but input from team members and their collaboration are the factors that make the process successful or not. A company should bear in mind that just the fact of acquiring a risk management tool will not be enough to run the process; the focus should be on people and the tool to support them.

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In the fourth section of the interview, respondents were asked to give their opinion about how this tool can help the risk management process, what the strengths and weaknesses are, and were asked for suggestions on changing the framework. The adoption of the framework to support the risk management process was perceived as positive by all respondents. This tool can support the process and stimulate team collaboration, creating an environment to permit team members to participate, give their input about risk information. One aspect cited by respondents is integration with other PM tools. As the framework is based upon wiki pages that do not do any kind of quantitative analysis, this tool should be integrated to store risk quantitative analysis and link with correspondent risks. A scheduling tool should be integrated to risk management; if the company adopts a web-based schedule tool, the risks related to any scheduled activity should be linked and accessed from the framework.

Participants mentioned, regarding companies that adopt portfolio tools, that it is important to create integration. A new project in the portfolio can be linked to existing risks identified in similar projects, and any new information about the risk will feed all projects affected by that. This integration can help diminish rework, and information does not need to be duplicated in different projects in the portfolio.

(E03): We cannot focus only on the tool, we need to focus on the entire process and emphasize the need for teamwork.

(E05): There are managers who think that if they acquire a tool that has been running successfully in another company, the result will be the same in their company. It is not just about acquiring a tool, people should be prepared and motivated to participate.

5. Theoretical and practical contributions

This research contributes to the literature by proposing a more collaborative Risk Management in projects, by means of a prescriptive framework. This research is classified as incremental originality [43] by introducing the W4RM framework. W4RM was built by gathering best practices in Risk Management literature and Wiki features to support IT PM. W4RM, as a prescriptive framework, denotes an action-oriented form of science, which is concerned with the development of recommendations on how to solve practical problems [44]. To the best of our knowledge, this paper is the first to propose the use of social media (a wiki) to support Risk Management. As a result, this paper introduces a new artifact to a traditional problem in the PM field.

Through the adoption of a constructivist ontology for this research, social interactions with practitioners served as an important pillar to sustain all the results presented. The focus group and interviews permitted the researcher to stimulate debates among experts regarding their problems and challenges in real life, connecting this research to the reality of project managers. W4RM is the result of these debates in groups and individual points of view analyzed by the researcher. Practitioners can adopt W4RM as a tool to support risk management. According to the results found in this research, project managers and PMOs are facing difficulties in implementing and executing risk management. The adoption of a collaborative tool with the schema suggested by W4RM can help them to improve collaboration, as well as help solve the difficulties they themselves described. W4RM serves as a means to facilitate project manager communication with the project team and stakeholders regarding risks. This framework will keep risk policies available for the employees in the company, helping project managers who perceive a disturbance to the project's environment when talking about risks [27]. Kutsch and Hall [23] describe that project managers do not talk about risks to prevent anxiety in the team and stakeholders. To face this issue, W4RM helps disseminate communication about risks and establishes a risk management culture in the community, defining institutional benefits before project initiation.

Studies report difficulties for the project manager regarding continuous risk management after risk identification [12, 13, 22]. W4RM is a collaborative tool that helps create an environment of collaboration from the community and to the community, facilitating continuous risk management. Project managers can inherit the community bias established in the framework to encourage collaboration with risk management alongside the project. Participants of this community can be in charge of identified risks, maintaining communication about any update of specific risks. This sense of collaboration may be used to keep the community identifying new risks and relating these risks with one or more

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projects. This attribute of W4RM can also help project managers with problems related to the lack of feedback concerning risk events occurrence, and document consequences.

6. Conclusion

This research shows how a wiki can support risk management in IT projects by proposing a prescriptive framework (W4RM), which was validated by PM experts through discussion in focus groups and individual interviews. Practitioners confirmed problems and difficulties found in the literature. Although risk management is recognized as an important process to support project success, it is executed partially. Project managers and PMO managers are unanimous about the need for collaboration from the project team. Risk management is practiced as an activity with the project manager in charge. Most of the project managers mention corporate culture as a barrier to the discussion of risks. They also agree that implementing a risk management process with a collaborative tool can create a culture to foster risk discussion, process participation and specialist discussions.

The findings reported are subject to at least two limitations. First, case studies were not conducted to validate and evaluate the framework proposed. Second, practitioners recognize that only implementing a tool is not enough to change a risk management culture; a robust implementation should be planned to gradually develop the raising of the entire company's awareness of the relevance of risk management. These issues should be taken into account in future research, which includes the deployment of W4RM in IT projects using action research or design science research to validate this framework in the field.

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Appendix A. Focus group protocol

Aspect	#	Question
Barriers and difficulties in risk management	1	What difficulties have you dealt with as you manage risks in IT projects?
	2	Can you list, in topics, these difficulties?
	3	Do you apply risk management in all projects that you manage?
	4	For those who don't apply risk management to all projects, "What are the main characteristics of the projects that you apply risk management?"
	5	How is your relationship with sponsors and stakeholders in the risk management process?
Risk Management Processes	6	What are the main steps that you apply to manage risks?
	7	How do you identify risks?
	8	How do you evaluate risks?
	9	How do you communicate risks?
	10	How are risks monitored and updated?
	11	According to your experience, what is the project management role in risk management
	12	In your opinion, what could the state-of-art be for a project manager role managing risks?
Web 2.0 tools		*Explaining concepts of Web 2.0 tools*
	13	What are the Web 2.0 tools that you know?
	14	In your opinion, how can a web 2.0 tool help manage risks?
Framework		*Framework alpha version presentation*
	15	What is your opinion about the use of wiki pages to create this framework?
	16	What are the positive and negative aspects of this framework?
	17	What changes do you suggest for this framework?

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Appendix B. Interview protocol

Aspect	#	Question
Respondent Profile Risk Management Experience	1	How old are you? How long have you been working as a project manager?
	2	What is the business sector of the organization you work for? Do you work as an employee of the organization, contractor or partner?
	3	Do you have experience in working with project management methodologies?
	4	Can you describe your experience in managing risks in projects?
	5	Have you implemented any risk management processes? If you have, how was this experience?
	6	In your opinion, is risk management important for project success? If so, why?
Collaboration in Risk Management Risk Management tools	7	In your opinion, in risk management, what are the roles of project team members, project sponsors and stakeholders? How do you work with these different groups (team members, sponsors, stakeholders)?
	8	In your work, how do you monitor the risks you identify during the project life-cycle?
	9	Do you report every risk you identify or do you omit some? Are there any types of risks you cannot inform to the ones involved in the project?
	10	In your opinion, how can a Web-based tool or application help project managers in their work in risk management?
	11	What are the most required functions for PM tools?
		Concepts of Web 2.0 technology
	12	What is your opinion about adopting a Web 2.0-based tool to manage IT project risks?
Framework	13	Do you have any experience in using wikis in professional settings? Or have you ever participated in implementations of Wikis in organizations?
		Presentation of the beta version of W4RM framework
	14	What is your opinion about the framework?
	15	What changes would you suggest?
	16	What practical advice would you give for a future implementation of W4RM framework in organizations?
Respondent Profile	1	How old are you? How long have you been working as a project manager?

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