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A PRESCRIPTIVE FRAMEWORK USING WIKI TOOL TO MANAGE RISKS IN INFORMATION TECHNOLOGY PROJECTS

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UM *FRAMEWORK* PRESCRITIVO UTILIZANDO WIKI PARA GERENCIAR RISCOS EM PROJETO DE TECNOLOGIA DA INFORMAÇÃO

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A thesis submitted to the Master's Degree Program in Administration with emphasis on Project Management of Nove de Julho University – UNINOVE, as a partial fulfillment for the degree of **Master in Administration**.

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DEDICATION

This thesis is dedicated to my beloved family, my mother who was present in my life all the time. To my extraordinary wife Ana, for supporting me and taking care of our son Rafael, a very special two-year old kid that many times tried to help dad typing letters in this thesis. To my daughter Sofia “in memoriam” I know you are in heaven, but that you will be beside me always.

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ABSTRACT

The importance of Information Technology (IT) projects for business is increasing and project results directly impact organizations' strategy and performance. In this scenario, risk management processes can help project managers to analyze the consequences of changes on project goals and baselines. By managing risks, project managers can have a holistic view of projects. Despite project managers recognizing the importance of risk management, many of them only manage risks partially or even, skip this process due to daily difficulties and time pressure. Wiki platforms have some characteristics and principles inherited from Web 2.0 tools that can be useful when adopted on risk management. Wikis can help project managers evolve their teams and stakeholders on the process of identifying, reporting and monitoring risks on projects. This thesis proposes a framework - the Wiki for Risk Management (W4RM) - that can be used on risk management in IT projects. The process of designing the framework was divided into three stages: literature review, one focus group and interviews based on a constructivist methodological approach. This research points out that professionals face a series of difficulties as they engage on risk management, as previously argued by other authors on project management research area. Due to these difficulties, project managers are not able to manage risks as expected. An important theoretical contribution of this research is the robust analysis existing issues on risk management in IT settings. Another contribution of this thesis is the proposed framework for risk management for IT projects. For managerial implication of this research the W4RM framework that can be used by practitioners on project management.

Keywords: IT project management; Risk Management; Web 2.0; Wiki.

RESUMO

A importância dos projetos de Tecnologia de Informação (TI) para os negócios aumentou e os resultados dos projetos impactam diretamente a estratégia e os lucros das empresas. Neste contexto, o processo de gerenciamento de risco pode ajudar gerentes de projeto a analisar as consequências das mudanças a serem feitas no objetivo e nas *baselines* dos projetos. O gerenciamento de riscos também permite aos gerentes de projetos a terem uma visão holística dos projetos. Apesar dos gerentes de projetos reconhecerem a importância do gerenciamento de riscos, muitos o fazem parcialmente, ou até mesmo não conseguem gerenciar os riscos devido às dificuldades diárias e à pressão do tempo. Plataformas wiki possuem algumas características herdadas das ferramentas Web 2.0 que podem ajudar gerentes de projetos no gerenciamento de riscos. Wikis também podem ajudar gerentes de projeto a envolver suas equipes e *stakeholders* nas discussões, na divulgação e no monitoramento dos riscos. Esta dissertação propõe um framework, chamado *Wiki for Risk Management (W4RM)*, a ser adotado em gerenciamento riscos de projetos de TI. A pesquisa foi dividida em três estágios: revisão de literatura, grupo focal e entrevistas conduzidas a partir de abordagem metodológica construtivista. Esta pesquisa concluiu que gerentes de projetos enfrentam uma série de dificuldades ao gerenciarem, dificuldades estas já apontadas em por outros autores na área de gerenciamento de projetos. Os resultados indicam que devido às estas dificuldades, gerentes de projetos não conseguem gerenciar riscos em seus projetos como esperado. Uma importante contribuição desta pesquisa para a teoria é uma robusta análise dos problemas existente no gerenciamento de riscos. Outra contribuição teórica é o framework proposto para gerenciamento de riscos em projetos de TI. Uma contribuição para a prática é que o framework W4RM pode ser usado por profissionais em gerenciamento de projetos.

Palavras-chave: Gerenciamento de Projetos de TI; Gerenciamento de Riscos; Web 2.0; Wiki.

SUMMARY

ACRONYMS

AOL …….American Online

API ……...Application Programming Interface

BI …….Business Intelligence

CIO ……..Chief Information Office

DrKW ….….bank Dresdner Kleinwort Wasserstein

IT …….Information Technology

PM ……...Project Management

PM 2.0….….Project Management 2.0

PMO ……Project Management Office

RM ……...Risk Management

RSS ……..Really Simple Syndication

SaaS …….Software as a Service

W4RM …….Wiki for Risk Management

WBS ……Work Breakdown Structure

WYSIWYG..What You See Is What You Get

LIST OF FIGURES

1. INTRODUCTION

Regardless of their size, organizations use Information Technology (IT) and to sustain technology they need to engage on IT projects every year (Kutsch, 2008). According to (Kutsch, 2008), IT projects are characterized by the accelerated progress to technology, which can be a challenge for organizations on their attempt to stay up to date. Another difficulty on IT projects is their complexity. More and more, IT project managers admit their inability to set tangible and feasible objectives (Gu, Hoffman, Cao, & Schniederjans, 2014). Blurry project objectives make people to change ideas very fast, and consequently, this instability causes delays and even the cancelation of projects (Gu et al., 2014).

Risk Management on project management (PM) takes into account the dynamism in projects settings and also on how this dynamism can cause uncertainty in project management (Sanchez, Robert, Bourgault, & Pellerin, 2009). Sanchez et al. (2009) also argue that this dynamism can cause changes on project costs, resources, project scope and even the characteristics of the final product. According to Sanchez et al. (2009), evaluating the consequences of changes on project results is the main goal of risk management. It is important to note that when the consequences of changes are negative, they are called risks; and when they are positive, they are called opportunities.

Another goal of risk management is sensing and taking advantage of opportunities and preventing (or minimizing) the impact of risks (Project Management Institute, 2013). Risk management can be considered a major success factor on project management (Pinto, 2007; Lehtiranta, 2014). Managing risks on IT projects can positively influence project results as it allows project manager to achieve predefined project objectives (Kutsch & Hall, 2009).

Many organizations have adopted softwares on project management. For this reason, a proper use of these tools can positively influence project results (Jugdev, Perkins, Fortune, White, & Walker, 2013). The use of Internet and e-mail have become fundamental means of communication within project teams. In fact, the use of Web 2.0 technologies have emerged in the last few years and can be useful tools on the management of IT projects (Gholami & Murugesan, 2011). Web 2.0 is the second phase of web evolution. According to Murugesan (2007), Web 2.0 technology stimulates the collaboration and interaction among users as well

as they improve generation, dissemination, sharing and refining of knowledge (Constantinides & Fountain, 2008).

One of the Web 2.0 tools is the wiki which has being adopted by organizations from different segments as a way to spur the interactivity and communication between teams (Standing & Kiniti, 2011). Besides that, organizations have used wikis on knowledge management (Yates, Wagner, & Majchrzak, 2010). Into PM, wikis have been used as a tool to organize and to disseminate information within project team members and stakeholders during the whole project life cycle. (Louridas, 2006; Auinger, Nedbal, & Hochmeier, 2013).

1.1. PROBLEM STATEMENT

Despite the fact that risk management is an important success factor on PM, many project managers and organizations, deliberately or not, do not fully manage risks on projects (Kutsch & Hall, 2009). The same study highlights how risks are sometimes ignored in project management and why those involved in projects (project team members, stakeholders and sponsors) do not participate on the identification and monitoring of risks in projects.

Talking about risks can be inconvenient when stakeholders and sponsors expect to see only the positive aspects on projects (Kutsch & Hall, 2010). Kutsch and Hall (2010) also affirm that to avoid anxiety among stakeholders, project managers avoid talking about uncertainties and negative aspects. Thus, many times people see risk management as a disturbing affair. Consequently, project managers tend to deal with risks only with their teams, excluding stakeholders.

Sometimes project managers decide to deal only with some specific risks, meaning that other risks are left out (Kwan & Leung, 2011). Kwan & Leung (2011) also say that the number of risks that project managers managed vary according to their personal perspective, project size or project complexity. Then, the decision to deal with risks can be strongly biased (Kutsch & Hall, 2010).

Another issue on risks management is the maintenance of databases containing historical information on risks faced on previous and current projects. When there is not a consistent and accessible historical database of risks, project managers have to start the identification of risks from scratch (Holzmann & Spiegler, 2011). Besides, when projects belong to the same setting or sector, they tend to have similar characteristics. So, when

organizations do not keep a historical database of risks on project, project managers miss the opportunity to define their set of potential risks faster and better. Holzmann and Spiegler (2011) affirm that, without a repository to store information on risks, organizations lose important information about previous failed projects which could help them avoiding to repeat the same mistakes.

Based on this scenario, this research proposes the use of wiki pages on the risk management on projects intending to answer the following research question: ***How can wikis support risk management in IT projects?***

The main objective of this thesis is to propose a framework for risk management in IT projects based on wikis. To achieve this main goal, I set the following specific objectives:

- To verify gaps in project management literature regarding risk management;
- To analyze how wiki pages can improve risk management;
- To develop a framework to support risk management based on wikis;
- To validate the proposed framework by getting feedbacks from experts.

1.2. JUSTIFICATION

This research aims to propose a framework to manage risks on IT projects based on wikis. In this perspective, all team members need to have access to the wikis so all people involved can contribute during the process of risk management. The use of a wiki platform will allow project managers to register risks and to generate a historical risk repository, accessible to all those involved in the project. Project managers can also use wiki pages to store risk management plans and suggestions from experts. Wikis can allow dynamic and collaborative relationship among team members and stakeholders (Shang, Li, Wu, & Hou, 2011). Additionally, an IT risks repository can be adopted and used by project management offices (PMO).

1.3. DELIMITATION OF THIS STUDY

For Bahli and Rivard (2005) project performance depends on three elements, people, process and technology. I chose to focus this research on the technology element of project performance.

1.4. THESIS STRUCTURE

After introduction, the thesis is structured as follows: (2) theoretical background, which presents the main concepts about risk management on the main PM guides. This chapter also presents how risks can be managed in IT projects. In addition, this chapter presents fundamental definitions and characteristic of wikis, how wikis can be used in organizations, and a preliminary framework based on wiki pages; (3) research design which described the methodological design adopted in this research; (4) result analysis which presents the results of the analysis of data collected in the field and discussion on research results; (5) contributions for academics and practitioners, presenting the main theoretical contributions and implications for practitioners in PM; (6) final remarks, presenting the main conclusions of this research and its limitations.

2. LITERATURE REVIEW

This chapter presents the theoretical background research that is the foundation for this thesis containing two fundamental pillars: Risk Management in IT projects and Wikis. Figure 1 shows the intersection between those pillars and the scope of this research, dashed square represents the context of this study in IT projects.

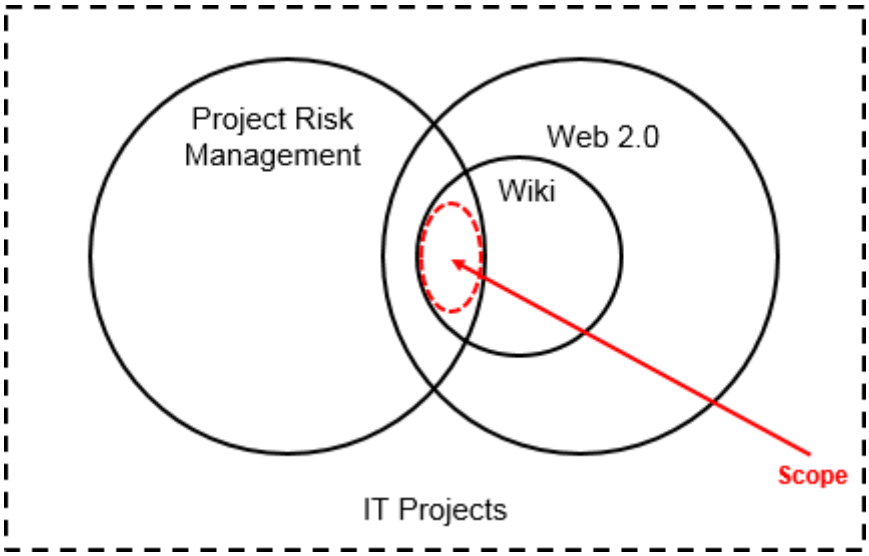

Figure 1 - Research Fundamentals Pillars and Context

2.1. RISK MANAGEMENT IN IT PROJECTS

This topic presents main concepts about risk management, is discussed how risk activities are presented in literature and, some of the best practices. After presenting main concepts about project risk management and, how some guides addresses this topic, is discussed some particularity about risk management in IT projects and, what activities or process are applied specifically to this kind of project.

2.1.1. Risk Management definitions

Before presenting what risk management is according to literature, it is important to present some definitions of risk. The definition of what is risk has not a unique concept, on

risk research history different researchers could have different understandings about what risk means, a definition of this term is always in dispute (Zhang, 2011).

Two different schools of researchers have categorized risks (Zhang, 2011). While one school categorizes risk as an objective fact, another one categorizes it as a subjective construction. Both schools present different risk definition and tend to recommend different risk management policies.

The viewpoints about risk as objective or subjective can also be considered as two endpoints of a continuum, so, the definition in researches about risk can lie between them. Figure 2 shows risk as an objective fact means that the risk exists free of people's mind and values. Risk as a subjective fact has two different aspects, first, people have a different identification of this, second, risks are not external and objective outcomes except the ones mediated by social construction, interplay, and process. Supporters of this school involve some researchers in sociology, anthropology, and psychometrics (Zhang, 2011).

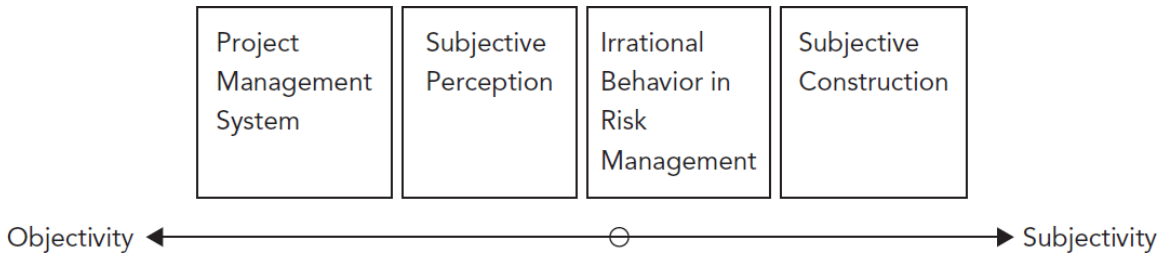

Figure 2 - Position of studies about Risk Managment

Note Source**:** Zhang (2011, pg. 9)

Due to this researched is studying risks in project, will be adopted the project management school position about risk management, where researchers that defines risk as objective. Zhang (2011) argue that when a new project starts the goals are pre-defined and the objectives to be achieved exists and are free of people's value or point of view. Generally, project managers or researchers with project manager role, care about how successfully will perform the project objectives, concerning about how to identify and analyze risks which may influence negatively the project objectives (Lyons & Skitmore, 2004).

The definitions of risk by authors presented in Figure 3 can be classified on the school of objective risks. The objective of the study is to validate how the artifact can help to avoid

threats on the objectives, or enhance opportunities. Therefore, the authors selected to the risk definition are those who define risks on PM context.

AUTHOR (S)	RISK DEFINITION
(Association for Project Management, 2014) p.60	"The word 'risk' can be interpreted in many ways. In this *Guide* two distinctly different uses are recognized. - The term 'risk event' describes an individual uncertainty which can be identified, assessed and managed through the project risk management process, and is defined as follows: 'A risk event is an uncertain event or set of circumstances that, should it occur, will have an effect on achievement of one or more the project's objectives.' - The term 'project risk' is used to describe the joint effect of risk events and other sources of uncertainty. At an overall project level, project risk, rather than individual risk events must be the focus, but it is important to understand how project risk is defined by its components and to manage it at both levels. Project risk is defined as follows: 'Project risk is the exposure of stakeholders to the consequences of variation in outcome'"
(Bannerman, 2008) p.2119	"The most common definition of risk in software projects is in terms of exposure to specific factors that present a threat to achieving the expected outcomes of a project."
(Boehm, 1991) p.33	"Webster's dictionary defines "risk" as "the possibility of loss or injury." This definition can be translated into the fundamental concept of risk management: risk exposure, sometimes also called "risk impact" or "risk factor". Risk exposure is defined by the relationship RE=P(UO)*L(UO), where RE is the risk exposure, P(UO) is the probability of an unsatisfactory outcome and L(UO) is the loss of parties affected if the outcome is unsatisfactory."
(Carvalho & Rabechini Jr., 2011) p.251	"For most of the people, risk is synonymous of adverse consequences, like financial loss and danger of accident and catastrophes. Therefore, the traditional concept of risk is defined as the impact of a negative event associated with the probability of this event occurs."
(International Organization for Standardization,	"Risk: effect of uncertainty on objectives NOTE 1 An effect is a deviation from the expected — positive and/or negative. NOTE 2 Objectives can have different aspects (such as financial, health and safety, and

AUTHOR (S)	RISK DEFINITION
2009) p.42	environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process). NOTE 3 Risk is often characterized by reference to potential events and consequences, or a combination of these. NOTE 4 Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence. NOTE 5 Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of, an event, its consequence, or likelihood."
(Jaafari, 2001) p.89	"Risk is defined as the exposure to loss/gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude. Events are said to be certain if the probability of their occurrence is 100% or very uncertain if the probability of occurrence is 0%. In between these extremes the uncertainty varies quite widely."
(Kerzner, 2009) p.743	"Risk is a measure of the probability and consequence of not achieving a defined project goal. Most people agree that risk involves the notion of uncertainty. When risk is considered, the consequences or damage associated with the event occurring must also be considered. Risk constitutes a lack of knowledge of future events. Typically, future events (or outcomes) that are favorable are called opportunities, whereas unfavorable events are called risks."
(Kwan & Leung, 2011) p. 635	"A risk is a potential event that will adversely affect the ability of a system to perform its mission should the risk event take place. A risk has two basic attributes, Probability P and Impact I, where Probability stands for the likelihood that an event will occur."
(Office of Government Commerce, 2009) p.77	"A risk is an uncertain event or set of events that, should it occur, will have an effect on the achievement of objectives. It consists of a combination of the probability of a perceived threat or opportunity occurring, and the magnitude of its impact on objectives, where: - Threat is used to describe an uncertain event that could have a negative impact on objectives - Opportunity is used to describe an uncertain event that could have a favorable impact on objectives.

AUTHOR (S)	RISK DEFINITION
	In the context of a project, it is the project's objectives that are at risk. These will include completing the project to a number of targets, typically covering time, cost, quality, scope, benefits and risk."
(Project Management Institute, 2013) p.268	"Project risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives such as scope, schedule, cost, and quality. A risk may have one or more causes and, if it occurs, it may have one or more impacts. A cause may be a given or potential requirement, assumption, constraint, or that creates the possibility of negative or positive outcomes."

Figure 3 - Risk definition

An important aspect of similarity among authors is the context of the project added in the risk definition. Some authors, (Association for Project Management, 2014; Bannerman, 2008; Kerzner, 2009; Office of Government Commerce, 2009; Project Management Institute, 2013), adds the context of project restricting the definition of risk in PM scope. Some of the authors add more restriction about the context, like, Bannerman (2008) that restricts his definition about risk for software projects. Adding this kind of restriction, defining some borders or scope reached by risk definition, it is accepted that a risk definition in another context that is not in project, may have a different aspect.

Another important aspect concerns about objective, some authors (Association for Project Management, 2014; International Organization for Standardization, 2009; Kerzner, 2009; Office of Government Commerce, 2009; Project Management Institute, 2013) relate risk events with project objectives or goals. That means, risks for those authors are directly related with objective and, a risk in the project is an event that affects one or more project objectives.

A recurrent theme among the authors in Figure 3 is the risk as an event with some probability of occurrence, or uncertainty of occurrence. The definitions of risks defined by those authors are accepted as an event that has some probability of occurrence accepting that a risk may occur or not and, sometimes, the probability of occurrence is not present and, in this case, authors treat the risk as an uncertainty. Therefore according to some authors, like

Association for Project Management (2014), Jaafari (2001) and Kerzner (2009), risks are events with some probability of occurrence, but when the probability is not described, those authors defines the risk event as uncertain.

To define the consequences of a risk event occurrence, some authors define the impact of the occurrence of an aspect of risk definition. The authors (Boehm, 1991; Carvalho & Rabechini Jr., 2011; Kwan & Leung, 2011; Office of Government Commerce, 2009) in their definitions of what risk is, relate the consequences of a risk as the product of the probability and the impact.

A common view among authors relates risk with negative impact, defining risks as a negative occurrence threatening the project or some objective in the project. Despite all authors relating risk with something negative, other (Boehm, 1991; International Organization for Standardization, 2009; Kerzner, 2009; Office of Government Commerce, 2009; Project Management Institute, 2013) consider that a risk may have positive consequences, calling this risk as an opportunity. For these authors, risks are not only related to a negative aspect and the positive aspects are another attribute of risk. The exception about relating risk with negative and positive aspects is Association for Project Management (2014), that does not associate risk neither with negative aspects nor with positive aspects, relating the occurrence with an effect on the achievement of project's objective.

With risk concept presented, risk management concepts and definitions can be discussed and analyzed. **Error! Reference source not found.** presents risk management rinciples defined by risk management researchers, risk management guides or PM guides. Those definitions contain the main objectives of the risk management that a project manager can address to manage risks successfully. The column “main concepts” is added to highlights what are the different aspects that can be found for each definition.

AUTHOR(S)	RISK MANAGEMENT DEFINITION	MAIN CONCEPTS
(Association for Project Management, 2014)	Risk management process is designed to avoid and minimize threats as well as to exploit and maximize opportunities. The aim of addressing both types of uncertainty in the single risk management process is	• Minimize threats and maximize opportunities; • Optimize achievement of project objective.

AUTHOR(S)	RISK MANAGEMENT DEFINITION	MAIN CONCEPTS
	to optimize achievement of project objectives.	
(Boehm, 1991) p.33	Software risk management is an attempt to formalize the risk-oriented correlates of success into a readily applicable set of principles and practices. Its objectives are to identify, address, and eliminate risk items before they become either threats to successful software operation or major sources of software rework.	• Formalize risk-oriented; • Identify some activities; • Threats elimination.
(International Project Management Association, 2006)	Risk and opportunity management is an ongoing process taking place during all phases of the project lifecycle, from initial idea to project closeout. At project closeout, the lessons learned in risk and opportunity management throughout the project are an important contribution to the success of future projects.	• Ongoing activity to be done all phase; • Lessons learned on project closeout.
(Jaafari, 2001)	Risk management involves modeling the project's objective functions against project variables, which include such variables as cost and quantities of input resources, external factors, etc.	• Relates risk management with project objectives.
(Kerzner, 2009)	Risk management is the act or practice of dealing with risk. It includes planning for risk, identifying risks, analyzing risks, developing risk response strategies, and monitoring and controlling risks to determine how they have changed.	• Identify some risk management activities.
(Office of Government Commerce, 2009)	The term risk management refers to the systematic application of procedures to the tasks of identifying and assessing risks and then planning and implementing risk responses. This provides a disciplined environment for proactive decision-making.	• Identify some risk management activities; • Relates with proactive decision-making.

AUTHOR(S)	RISK MANAGEMENT DEFINITION	MAIN CONCEPTS
(Project Management Institute, 2013)	Project Risk Management includes the process of conducting risk management planning, identification, analysis, response planning and controlling risk on a project. The objectives of project risk management are to increase the likelihood and impact of positive events and decrease the likelihood and impact of negative events in the project.	• Identify some risk management activities; • Minimize threats and maximize opportunities.

Figure 4 - Risk Management Definition

All the authors in Figure 4 are defining risk management in PM context. However, it is possible to identify for each of them different emphasis about what are the principles for risk management. The column main concepts highlight the main aspects presented by an author that is not present in any other definition. An author with use exclusive aspects to define risk management is International Project Management Association (2006), relating risk management with project's phases and lessons learned.

Although the risk management for each author in Figure 4 has a unique description and some main aspects defined are unique too, is possible find some common aspect among the authors. The first of them is the use of describing some main activities, emphasizing the execution of these activities for risk management successful. The authors (Boehm, 1991; Kerzner, 2009; Office of Government Commerce, 2009; Project Management Institute, 2013), has their own list of activities that they present as important to be done, but some activities like identification is present in all the definitions as an important activity.

Another aspect described for some authors has related the risk management with project's objective. The authors (Association for Project Management, 2014; Jaafari, 2001), to execute risk management is needed to align the activity with project's objective. This definition can enrich the process of risk management when aligned with a risk definition as an event related that could affect project's objective.

One more aspect cited by more than one author is the relation between risk management and threats and opportunities. The need of maximize opportunities and minimize threats is present on the definition of the authors (Association for Project Management, 2014; Project Management Institute, 2013). The author Boehm (1991), does not cite opportunities

on his definition, but, highlights that risk management should eliminate threats to successful software operation.

2.1.2. Risk Management process according to standards

The purpose of this section is to present and to discuss the risk management processes according to PM and risk management standards, to discuss similarities among them and particularities of one standard. Analyzing what is proposed by those standards, will allow identifying best practices for project management, common activities to be done and terms and definition used in risk management. Project Management Body of Knowledge (PMBOK) by the PM Institute, the IPMA Competence Baseline (ICB) by the International PM Association, and Prince2 by The Office of Government Commerce UK are heavily established PM standards and adopted by many researchers on literature (Sanjuan & Froese, 2013).

2.1.2.1. Risk Management process according to PMBOK guide

Project Management Institute (2013) presents Risk Management as one of ten knowledge areas for project management. According to guide, a knowledge area represents a complete set of concept, terms, and activities that make up a professional field, PM field, or area of specialization. The risk management is composed of six processes that are, Plan Risk Management, Identify Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, Plan Risk Response and Control Risk. These processes interact among them and, interacts with the process of another knowledge area. The process inside Risk Management process is executed in a specific order. The first process to be executed is Plan Risk Management, this process aims to ensure the degree, type and visibility of Risk Management in commensuration with the importance of the project in the organization (Project Management Institute, 2013). This process will produce a plan describing how the activities will be structured and performed.

The second process for Risk Management in PMBOK is Identify Risks, this process aims to identify risks that may affect the project and document their characteristics. The third

process to be executed is Perform Qualitative Risk Analysis, on this process, the risk is assessed combining their probability of occurrence and impact. Execute this process will enable project managers to reduce the level of uncertainty and focus on high-priority risks (Project Management Institute, 2013). The fourth process is Perform Quantitative Risk Analysis, where is done a numerical analysis of the risks on projects objective. This process produces numbers that will feed probabilistic analysis, like, the probability of a project activity finish on time or the probability for the project achieve project objectives. The fifth process Plan Risk Response aims to develop options and actions to enhance opportunities and reduce threats. This process will produce updates not only in the Risk Management plan but in the other knowledge areas too.

After finished the five risk management processes, Control Risk is the process of implement the risk response plan, in this process, the previous process can be executed again. Executing this process, new risks can be identified and after that, all the sequences of activities should be done resulting in updates on Risk Response plan. This process improves the efficiency of risk management throughout the project life-cycle with a continuous risk response (Project Management Institute, 2013). Perform this process creates mechanisms to communicate and support project decision makers.

2.1.2.2. Risk Management process according to PRINCE 2

Risk Management is one of the seven themes described on PRINCE2. Office of Government Commerce (2009) defines a theme as an aspect of PM that must be addressed continually. Each theme is structured with a purpose, justifying why is important that theme, with a definition of terms, with the approach to the theme, specifying specifics treatments required, and with responsibilities that define specific roles for the theme.

The purpose of Risk theme is to identify, assess and control uncertainty and, as a result, improve the ability of the project to succeed. Manage risk is a systematic activity that cannot be based on chance. It is a proactive activity that identifies, assess and control the risk that might affect project's objective (Office of Government Commerce, 2009).

Some of the principles for Risk Management on PRINCE2 are, understand the project's context, involve stakeholders, report risk regularly, monitor for early warning

indicators and define clear role and benefits. To execute risk management, are recommended five steps that are, identify, assess, plan, implement and communicate. Different of the first four elements that are sequential, communicate is a step running in parallel with the others because any finding in other steps should be communicated prior to complete the overall process (Office of Government Commerce, 2009).

The first element is Identify, the primary goal is to identify the context of the project, to understand specifics objectives at risk and formulate risk management strategy. Assess is the second element of risk management, this element is divided into two steps. The first step is Evaluate, which the primary goal is to assess threats and opportunities and the respective probability and impact. The second step for Assess element is Evaluate, which the primary goal is to assess the effect of risks on a project when aggregated together. The third element is Plan, the primary goal for this element is prepare a response plan, ideally removing or reducing threats and maximizing opportunities. The fourth element of risk management is Implement, the primary goal for this element is ensure that risk response planned are actioned and the effectiveness is monitored. The last element is Communicate, this fifth element is carried out continually and aims to ensure that information related to the risks are communicated in the project and externally to stakeholders.

2.1.2.3. Risk Management process according to IPMA

In IPMA competence baseline, Risk Management is one of twenty technical competence elements. Technical elements are described as competencies needed to start, manage and execute a project. The importance of one technical element compared with other may vary depending on the size and complexity of a project and, other facts can influence this order (International Project Management Association, 2006).

Risk and opportunity management is described by International Project Management Association (2006), as an ongoing process that must take place in entire project life-cycle. The process must start with the initial idea to project closeout registering the lessons learned. The project manager is responsible for keeping all team members working proactively to alert risks and opportunities.

The element risk management contains seven steps:

- 1 – Identify and assess risks and opportunities;
- 2 – Develop a risk and opportunity response plan and have it approved and communicated;
- 3 – Update the different project plans affected by the approved risks and opportunities response plan;
- 4 – Assess the probability of attaining time and cost objectives and keep doing it during the project;
- 5 – Continuously identify new risks, reassess risks, plan responses and modify the project plan;
- 6 – Control the risk and opportunity response plan;
- 7 – Document lessons learned and apply to future projects; update risk identification tools.

To be able to manage risks, International Project Management Association (2006) lists the key competencies needed for each level of certification, that are:

- A – Has successfully directed the management of risk and opportunity for important programs and/or portfolios of an organization or an organizational unit.
- B – Has successfully managed the risk and opportunity situations of a complex project.
- C – Has successfully managed the risk and opportunity situations of a project with limited complexity;
- D – Has the knowledge required concerning the management of risks and opportunities in projects and can apply it.

2.1.2.4. Risk Management process according to CMMI for Development

Software Engineering Institute (2010) presents Risk Management as one of twenty-two process area. A process area is defined as a cluster of related practices when implemented collectively satisfies a set of goals making an improvement in that area. Risk Management is presented as a process in maturity level 3, categorized as Defined. There are five levels of

maturity, the maturity level 3 is the process are well characterized and understood, with standards described, procedures and tools. At level 3, processes are managed more proactively when compared with level 2, with a clear relationship other process activities.

Risk management is a continuous process, identified as an important part of project management. This process should address issues that could put in danger the achievement of critical objectives. The process Risk Management contains three specifics goals, that are, Prepare for Risk Management, Identify and Analyze Risks, Mitigate Risks. Specific Goal is defined as a required component that describes characteristics that must be present the process area (Software Engineering Institute, 2010).

The first specific goal is Prepare for Risk Management, this practice aims to establish and maintain a strategy for identify, analyze and mitigate risks. The strategy defined is documented in the risk management plan, addressing specific actions and management approach to applying and control the risk management program. The second specific goal is Identify and Analyze Risks, the objective of this practice is determine the degree that the risk affects the resource assigned to handle the risk and the appropriate timing when attention is required. The third specific goal is Mitigate Risks, the main objective for this practice is handle and mitigate risks to reduce adverse impacts on achieving project objective.

2.1.2.5. Risk Management process according to PRAM

In the guide Project Risk Analysis and Management, the process risks management comprises five phases and a ‘Manage Process’ activity. Each phase in the guide is a mandatory implementation, although is recognized that a different level of implementation can be done for each of them according to project complexity. The degree of maturity of organizational risk management capability will influence too in the level of risk management process implementation (Association for Project Management, 2014).

The risk management process is defined as iterative itself, the output produced by one phase requires revisit previous phase. The initiate is the first phase of the risk management

process. The purpose of this phase is set objectives, scope, and context for the risk management process. The second phase is Identify, that aims to identify as comprehensible as possible the risks events relevant to the project. Response for those risks may be identified during this phase. After identifying risks the third phase is Assess, the objective of this phase is to increase the understanding of each identified risk to support the appropriate and effective decision to be taken. The fourth phase is Plan Responses, this phase exists to develop an appropriate response for each risk event and ensure that project risk assessment is used to modify project strategy. The fifth phase is Implement Response that aims ensure the effective actions are taken based on decisions made in Plan response phase. The activity Manage Process exists to ensure that risk management process remains effective addressing identified risks. Execute this activity is the responsibility of the project manager, who must ensure that the process is applied to the project and is effective in terms of resource usage all the time.

2.1.2.6. Comparing Risk Management Standards

After the presentation of the risk management process in five standards guides, this section aims the identification of patterns among the guides, identification of particularities and find out mandatory steps for implementing a risk management process based upon steps that are required in all guides. Comparison to identify potential similarities, among PM standards, can provide an integrated vision on all levels to take into account to establish processes (Sánchez, Gaya, & Peréz, 2013).

Analyzing and comparing the guides has permitted to identify common steps managing risks. The common steps identified on guides are:

- Identification - with different names and terminology all the guides identifies a step to perform this action;
- Assessment - this step is performed by all guides but in different ways. Some of them execute in one step and others in two steps;
- Response Strategy – the guides proposes responses strategies according to project's strategy, budget, priorities and prioritization of risks.
- Communication – The guides suggests an effective communication establishing recurrence and periodicity to internal team and stakeholders.

- Control – This phase is presented in all guides, in some guides, this step starts after a response strategy is created and communicated, in other guides this step start with the beginning of risk management process.

In Figure 5 is identified how the common steps are performed in each guide, what are the activities identified in the steps, the order of execution for each one, and some particularities identifying actions or process descriptions strategies that are exclusive in each guide. The terminology used in each guide is used to discuss the activities.

	PMBOK	PRINCE2	IPMA	CMMI-DEV	PRAM
# of steps – terminology	6 – called process	5 – called elements	7 – called steps	3 – called specific goal	5 – called phases 1 – called activity
Context of risk management	1 of 10 knowledge areas. The context of project management.	1 of 7 themes. The context of project management.	1 of 20 technical competencies. The context of project management.	1 of 22 process area. Context of software development	Dedicated to risk management
How starts the process	Executing plan risk management	Identifying risks and formulating RM strategy	Identifying and assessing risks and opportunities	Establishing strategy to identify, analyze and mitigate risk	Setting objective, scope and context for RM
How identify risks	Executed after plan RM. Suggests tools and techniques. Creates a preliminary risk response.	Is the first element. Recommends the description of the aspects, cause, event and effect of the risks.	Is the first step. Indicates some techniques to risk identification	Is the first specific goal. Must identify events that put in danger the achievement of project's objective.	Executed after Initiate phase. Suggests compilation of risk list. Stakeholders should be consulted.
How risks are analyzed	Employs 2 processes, to perform qualitative analysis and quantitative analysis. Combine probability and impact and after, a numerical analysis for each risk.	In the element Assess. Divide the asses into two steps, first to assess probability and impact. The second to assess the effect of all aggregated risks on the project.	Executed in step 4, assess the probability of attaining project's time and cost.	Executed on second specific goal. Entails risks identified and evaluate each risk to determine likelihood and consequences.	Executed on the third phase using qualitative and/or quantitative analysis.

	PMBOK	PRINCE2	IPMA	CMMI-DEV	PRAM
How risks are formalized and strategy established	In the fifth process Plan Risk Response performing actions to enhance opportunities and reduce threats. Updates all project plan.	In the third element Plan, preparing a response plan reducing threats and maximizing opportunities. Should be made with provisions for a fallback plan.	Done in second, third and fifth steps. Communicate a response plan, update other project's plan and plan responses.	In the third specific goal, developing a risk mitigation plan containing contingency plan to deal with risk impact when occur.	On Plan Response phase, developing a reasonably strategic level of planning according to project needs.
How risks are communicated	In Control Risk process, performing this process creates mechanisms to communicate and support project's decision-makers.	In Communicate element, execute this element ensures that risks information are communicated internally and externally to stakeholders.	In fifth, sixth and seventh steps, the project plan is updated and communicated, lessons learned are registered and risk identification tools are updated.	In third specific goal, the mitigation risk plan is communicated	In the fifth phase, the internal team is engaged as risk responsible, stakeholders should receive an accurate risk information.
How risks are controlled	In Control risks process, executing this process new risks are identified and improves the	The elements are sequential running throughout project life-cycle	In the step Control Risk and Opportunity monitoring events and updated response plan	In third specific goal, risk responsible monitors and perform a response to events	In activity manage process project manager is responsible for performing formal RM

	PMBOK	PRINCE2	IPMA	CMMI-DEV	PRAM
	efficiency of RM throughout project life-cycle			according to risk handling option.	reviews.
Particularities (exclusive activities or characteristics)	• Performs qualitative and quantitative analysis for every risks; • Suggests tools and techniques for every process and identifies process outputs	• Elements based on PDCA, running throughout project life-cycle	• Identifies competencies and level required to project managers in RM.	• Establish the relationship between RM area and the organizational maturity level.	• Defines links and roles of interactions among all RM phases.

Figure 5 - Comparison of Risk Management Standards

2.1.3. Risk Management issues

A number of prior studies have pointed that, in general, risk management contributes to project success or influence positively project performance and results. Raz, Shenhar and Dvir (2002), investigating over 100 projects in a variety of industries, found that risk management practices appear to be related to project success, impacting mainly on better meeting time and budget goals. The study made by Cooke-Davis (2002), that researched more than 70 large organizations, found correlate significantly between risk management practices like adequacy with which a visible risk register, adequacy of an up-to-date risk management plan, among others with project on-time performance.

Most recently, studies are being presented relating risk management practices and project success. Zwikael and Ahn (2011) show a result of a survey administered for 701 project manager, relating that risk management moderates risk level and project success, and risk management reduces the negative effect of risk events on project success. Rabechini Junior and Carvalho (2013), investigating more than 400 projects, found a significant and positive impact of risk management on project success, including a success perception being impacted positively by risk manager. Oehmen et al. (2014) administering an investigation on 291 product develop programs, found a positive association among ten risk management practices and project success. IT projects are exposed to a greater number of risks due to their technological dependence, monitoring and mitigating risk related with technology dependency can contribute to project success (Glória Júnior, Chaves, & Silveira, 2015).

There are some studies relating that could not find relation between risk management and project success (Bakker, Boonstra, & Wortmann, 2010) , and there are studies reporting that despite project manager agrees that risk management can influence positively on projects success, they not apply risk management process in their projects (Kutsch & Hall, 2009). This section will discuss some problems on PM execution and reasons in not apply risk management process, presented in literature.

A problem presented on risk management literature is about project managers avoiding to talk about risk with project's team and stakeholders. Kutsch (2008) interviewing

IT project managers and testing patterns with a survey for project managers, found that when risk were perceived as discomforting on project's environment, project managers tend to ignore risks. In the same study was presented that sometimes, project manager tend to consider risk management as outside of their scope letting risk to be solved by itself.

Executing risk management processes enables the project manager to expose identified risks and manage them, however, when a project manager exposes a risk can also create an anxiety and native thoughts on stakeholders and team (Frosdick, 1997). Kutsch and Hall (2009), interviewing 18 IT project managers found the same problem of anxiety, found project managers avoiding identify and present risk, the reason was to not unnerve stakeholder also, not lose projects to another service provider. In some scenarios, project managers to reduce anxiety among customers and stakeholders not confront them with uncertainties and risks.

Project managers sometimes do not discuss risks to not create for themselves an image of not controlling their projects. The project environment can influence project managers in no apply risk management process, stakeholders may not accept discuss risk and impacts, in this case, there are project managers that tend to deny all risks. Stakeholders can act selectively about risk response, in this case, some risks are analyzed and responses are planned, but for risks that require money or resource investments the stakeholders does not accept to discuss (Kutsch & Hall, 2005).

On risk estimation process, some problems are related to project manager bias, when a project manager overestimate her capacity of controlling events. Jani (2011), classifies risk in two categories based on PM control over the risks factor that is, endogenous and exogenous. Endogenous are risks related with project's internal factors and are under direct control of project managers, like inadequate training, team morale, etc. Exogenous are risk with facts that are not under project manager's control, like, governmental regulation, changes in business environment, etc.

Jani (2011) found results that project manager's self-efficacy perception can interfere with risk perception and estimation. Project managers with higher self-efficacy perception may underestimate risks of IT projects when compared with project managers with lower self-efficacy. Piperca and Floricel (2012) investigation 17 complex projects in IT, pharmaceutical and construction industries, found that project managers underestimated certain risks,

categorizing risks and uncertainty, the authors found the project manager's tendency in underestimate some categories of risks.

Another related problem on risk management process is about controlling risks. Baber (2005) investigating five projects in the construction industry and four projects in IT industry, found problems related to risk control. The researcher found that despite project managers has conducted some degree of risk assessment and risk data were clear, risks were poorly managed. Project managers applying risk management standards, are not continuous managing risks applying their process on risk evaluation and assessment. Sanchez et al. (2009) found that some project managers do not apply continuous risk management, after risk identification and assessment, new threats are not being identified.

Reviewing the literature from 1997 to 2009 investigating empirical evidence on papers, Bakker, Boonstra and Wortmann (2010) did the research to answer the question, Does risk management contribute to IT project success? The researchers did not find an answer to this question. They found that risk management is being applied with a focus on finding risk factors rather than on how to manage risks. This evaluation approach is not enough to validate the contribution of risk management to IT project success. For the researchers, risk management not being applied according to guides criteria, can only be efficient in specific situations that may vary according to project's environment.

This section has presented some difficulties in different aspects of risk management. Figure 6 shows the difficulties presented in this section and authors that report those difficulties.

RISK MANAGEMENT DIFFICULTY	**AUTHORS**
Avoid risk identification to avoid anxiety on stakeholders.	• Frosdick (1997); • Kutsch (2008); • Kutsch and Hall (2009).
Project manager's efficiency perception.	• Kutsch and Hall (2005).

Project manager's self-efficacy perception can interfere with risk perception and estimation.	• Jani (2011); • Piperca and Floricel (2012).
Problems related to risk control.	• Baber (2005); • Sanchez et al. (2009).
Risk management focusing only on find risk factors.	• Bakker, Boonstra and Wortmann (2010).
Project manager tends to consider risk management as outside of their scope letting risk to be solved by itself.	• Kutsch (2008).
Project managers avoiding identify and present risk, the reason was to not unnerve stakeholder also, not lose projects to another service provider.	• Kutsch and Hall (2009).
Project managers sometimes do not discuss risks to not create for themselves an image of not controlling their projects	• Kutsch and Hall (2005).
Stakeholders may not accept discuss risk and impacts	• Kutsch and Hall (2005).
Project manager's tendency in underestimate some categories of risks	• Piperca and Floricel (2012).
Not apply continuous risk management when controlling risks	• Sanchez et al. (2009).

Figure 6 - Risk difficulties by authors

The usage of an appropriate tool can help project managers on risk management processes and improve communication among project's team and stakeholders (Sanchez et al., 2009). Next section presents a literature review about main aspect of wiki tools, their application on organizations and projects.

2.2. WIKI

After a review of project risk management that is the first pillar that sustains this thesis, wiki is the second pillar and this section aims to present main concepts and properties of web 2.0 and wiki, introduces some of web 2.0 technologies and the different usage for those technologies. After that will be presented wiki, defining the principles listed on literature and discuss usage on organizations and projects. Difficulties to wiki implementation and suggestions to implement are discussed to finish this topic.

2.2.1. Web 2.0 principles

Web 2.0 is the second phase in the Web's evolution. This evolution is attracting the attention of many IT professionals, business and web users (Murugesan, 2007). According to the same author, this new web is a people-centric web, a participative web with read/write contents. In the same study, Murugesan (2007) affirms that working in a collaborative manner, stimulates social interactive and collective intelligence, engaging users not only to consume content but, to produce, change and share it.

The term Web 2.0, was first coined by Tim O'Reilly and Media Live International. The first use was in the end of 2004 when O´Reilly and Media Live International used the term to name a series of conferences held by them. After that, the market has a rapid acceptance for this new wave, adopting names and ideas, and Web 2.0 became an important place to be explored by companies dot com (Levy, 2009). The objective of define the term Web 2.0 was to distinguish activities from traditional web pages static and passive to a dynamic and interactive knowledge creation on the internet. Using this platform, users are able to contribute and create content to multiple databases simultaneously. This approach contributes to build the collective intelligence that enriches the user experience and provides a unique source of information (Shang et al., 2011).

After some changes on Web 2.0 definition, Musser and O´Reilly (2007) has defined Web 2.0 as:

> "Web 2.0 is a set of economic, social, and technology trends that collectively form the basis for the next generation of the Internet - a more mature, distinctive medium characterized by user participation, openness, and network effects."

An important observation from Musser and O´Reilly (2007) is that the definition of Web 2.0 is a starting point for studies about it, but more important than the definition is underlying patterns and define some principles to a successful exploitation of Web 2.0. About those principles the author has established eight, although each of the principles is unique they are not independent, in fact, they are quite interdependent. The principles define by the authors are:

- Harnessing Collective Intelligence – presents a participation architecture, using network effects and algorithms to produce software that gets better the more people are using it. Grace (2009) found in her research that companies can save money adopting tools that enable and stores information created collectively.
- Data is in the center – Use is unique and different for each user and cannot be recreated. For this era, data become an important function. Hesse et al. (2011) describe that companies like Netflix, Amazon uses the benefit of the data to define consumers patterns and offer different product and services according to those patterns.
- Innovation in Assembly – The platforms stimulates innovation in assembly, where mixing services and data creates a new market and opportunities. Investigating the maturity of Web 2.0 tool in some banks, Nueesch, Puschmann and Alt (2012) found that adopting this principle some banks uses APIs from other providers (e.g. route planner, etc.) and integrates them into the company's website.
- Rich User Experience – Go further the traditional webpage metaphors to deliver rich user experiences combining software on desktops and software online. Web 2.0 applications increasingly adopt this principle to build an enticing virtual world (Kim, Yue, Hall, & Gates, 2009).
- Software Above the Level of a Single Device – Softwares are created not focused on specific devices aiming to be used on internet-connected devices and builds on the growing pervasiveness of online experience. Many successful websites like Wikipedia, Yahoo, Facebook and Google adopts these principles enabling peer production and raising the productivity (Lee, Kim, & Raven, 2014).

- Perpetual Beta – Softwares are not developed and launched in a specific version, they are developed in favor of online using and are in continuously update, adopting a Software as a Service (SAAS) model. The services are developed as lightweight modules and are released constantly, almost continuously and the users become hidden partners of the quality assurance process (Levy, 2009).
- Leveraging the Long Tail – Capture the profitability of niche markets exploring the low-cost economics and broad reach enabled by the Internet. Web sites and services can be created to be used and collaborated by some specifics group or niches rather than supporting only mainstream needs (Levy, 2013).
- Lightweight Models and Cost-Effective Scalability - Use the models of lightweight-business and software-development to create products and businesses quickly and cost-effectively. Adhering to this principles will mean developing the minimum functionality, and designing the system to integrate with other business and open source systems to enable further collaboration (Swisher, 2007).

Although Musser and O´Reilly (2007) presents many principles, advantages and ways to explore Web 2.0 technology, the authors present to issues about Web 2.0. The technologies based on those principles can bring some issues with it, such as:

- Walled gardens 2.0 – In Web 1.0 there is an example of walled gardens by American Online (AOL) where users were welcomed to create content and community as long as it occurred within the wall of AOL.
- Privacy and liability for individuals – People are revealing more details about themselves online including their history, relationship, dating and so on. That information can be mined by other people, including employers performing checkers, single investigators, and government agencies.
- Quality, not just quantity, matters – Users are not equal and their contributions are different too. Some companies create rewards to encourage participation.

Not only the money but also the desire for status, reputation, and attention can motivate users to participate. Sometimes that participation only adds quantity for the content without any other contribution.

- Who owns your data? – Users can and should control their own data, but this is often at odds with the commercial interests of companies whose key assets come from those contributions. It is important to establish, content ownership policies and ensure that intellectual property guidelines are published and in place.
- Copyright – Often this issue surface when people are given the ability to share content. Sometimes users deliberately share copyright material such as music, videos, and books.
- Technology Gaps – Many web services are technologically incomplete solutions, with problems in areas such as security, transaction support, and localization.
- Beware of releasing trash – Short release cycles quickly become inefficient and counter-productive if not supported by appropriate internal tools and process.
- Overuse – Beware of the "because you can" in design and development to add many functionalities not being user-friendly or useless. Usability and user-centered design should still come first.

When Web 2.0 technologies are developed based upon some of the presented principle, allows developers and companies obtain the benefits of that. However, some issues can be inherited and they should be addressed to be avoided or mitigated. Figure *7* shows the principles with some examples of Web applications and the issues for each of those principles.

PRINCIPLE	EXEMPLAR	PRACTICE	ISSUE
Harnessing Collective Intelligence	• Google • Wikipedia • Facebook • Amazon • Twitter	• Network effects by default • Involve users explicitly and implicitly • Trust your users • Software that improves the more people use it	• Trust • Quality • Walled gardens • Privacy

PRINCIPLE	EXEMPLAR	PRACTICE	ISSUE
Data is in the center	• Amazon • eBay • Facebook • NAVTEQ	• Network effects by default • Seek to own a unique source of data • Some rights reserved, not all • Following existing standards • Enhance the core data	• Ownership • Copyright
Innovation in Assembly	• Google Maps • Amazon • Salesforce.com	• Think platforms, not just applications • Create open APIs • Build your business model into your API • Be your own platform customer • Granular addressability of content	• Terms of service • Business model
Rich user experience	• Facebook • Gmail • Google Maps • Netflix	• Usability and simplicity first • Deep, adaptive personalization	• Overuse
Software Above the Level of a Single Device	• Facebook • iTunes • TiVo • Netflix • Skype	• Usability and simplicity first • Design across devices, servers, and networks • Use the power of the network to make the edge smarter • Think location aware	• Incompatibilities
Perpetual Beta	• Facebook • Google • Amazon	• Usability and simplicity first • Release early, release often • Users as co-developers • Make operations a core • Competency	• Quality vs. speed
Leveraging the long tail	• Amazon • eBay • Facebook • Google • Netflix	• Algorithmic data management • Customer self-service • Search, filter, and aggregation	• Privacy • Data owner
Lightweight Models and Cost-Effective Scalability	• Flickr • Instagram • Snapshot	• Syndicated business models • Scale pricing and revenue models • Outsource non-essential functions	• Sunk by network effects •

PRINCIPLE	EXEMPLAR	PRACTICE	ISSUE

Figure 7 - Web 2.0 Principles - Examples and Issues

Source: Adapted from Musser and O´Reilly (2007)

Adding value to the study of Musser and O´Reilly (2007), Levi (2009) aimed to understand the Web 2.0 phenomenon and, among others conclusions, the author presented three Web 2.0 principles:

- Web as platform – The Web is treated not as the main application but as a platform. Comparing to a telephone, the conversation is the essence and the telephone just the channel, Web 2.0 application as just channels. Companies that understood the concept are selling the channel, service through which people consumes content. Amazon, Facebook, and eBay seem to be channels that do not own the content.
- Services development – Derived from the definition of the web as platform, this principle is based on developing services instead of developing applications. The value added by this principle is that allows develop one main service assembled in other services.
- Active participation of users - Users are active participants and give add value to content. The level of participation is not the same for entire Web, users can be a passive participation giving the history of his participation, for example in amazon.com recommending books. The participation can be minimal, adding content to other people's content, tagging or creating content as individual (i.e. Blogs). Moreover, them, the user can be active users working over the net creating collaborative contents. For examples: wiki, Google spreadsheets, etc.

Understand the Web 2.0 principles and those patterns are key to navigate the Web 2.0 era. Executives, entrepreneurs, enterprise and thought leaders are acting on this market. Combining drivers and the principles provide what is needed to implement Web 2.0 technologies in the products and organizations (Musser & O'Reilly, 2007). Inheriting the principles of the web 2.0, wiki definition and applications are defined in next sections of this chapter.

2.2.2. Wiki definition

The first wiki system was created on 1990's, WikiWikiWeb platform was created to address needs of a group of programmers. The word wiki was defined by the father of Wiki technology Ward Cunningham and means quick or fast. The reference is for a website with interlinked web pages being created through web browsers and the syntax of a simple markup language through a WYSIWYG (What You See Is What You Get) editor (Lykourentzou, Dagka, Papadaki, Lepouras, & Vassilakis, 2012).

Wiki application has demonstrated that have high potential to facilitate knowledge creation, sharing, utilization and integration. The use of wikis is increasing in different contexts like education, research, business, government and public. It enables a collaborative environment permitting voluntaries and groups to create and edit documents incrementally (Zhao, Zhang, Wagner, & Chen, 2013).

The Wiki technology is characterized by various features or attributes, some of those attributes are interlinking attribute, wiki pages are connected through hyperlinks; edit feature, allows users to change content; preview, a wiki page can be previewed before publication and storage (Lykourentzou et al., 2012). According to same authors, there a number of other features related to wiki in various aspects covering structure, syntax, security and personalization. Figure 8 summarizes attributes of wiki technology, categorized by according to functionality and respective description.

CATEGORY	**FEATURE**	**DESCRIPTION**
Basic	Version Handling	• Enable handling of the changes performed among page version; • Includes version tracking and version comparison.
	Discussion	• Enable discussions among the wiki users; • May include comments threaded forums formats.
	Multi-language support	• Offers support in various languages.

CATEGORY	FEATURE	DESCRIPTION
Syntax formatting	Basic text formatting editor	• Simple editor that formats text based on the wiki syntax.
	WYSIWYG editor	• Rich text editor that supports the WYSIWYG functionality.
	Wiki syntax to HTML	• Script to automatically transform text written according to wiki syntax to HTML format.
Structure	Taxonomy	• Categorization of the wiki content based on a taxonomy.
	Folksonomy	• Allows users to add categorization tags on the wiki content.
	Ontology	• Uses an ontology to add structure to the wiki content.
	Document structure editor	• Allows wiki users to collaboratively edit the structure of the wiki content.
Search-navigation	Full-text search	• Search throughout the wiki content
	Tag supported navigation	• Navigation based on the tags placed on the wiki content.
	Semantic querying	• Semantic search and reasoning facility.
Security	Access permission levels	• Providing support of different access levels to the wiki user groups.
	Captcha	• Feature to prevent bots from infiltrating the wiki.
Personalization	Personalized views of the system	• Allows personalized views of the system through different templates/skins.
	Personal user pages	• Allows users to create their own pages.

CATEGORY	FEATURE	DESCRIPTION
Computing capabilities	Algorithm support	• Allow the use of algorithms (e.g. Monte Carlo, decision tree).
	Business queries	• Feature to formation of business queries (e.g. on SAP models).
Special Pages	Sandbox	• A wiki page intended to allow users practice on the wiki editing.
	Term glossary	• A wiki page containing a glossary of terms used by the wiki content.
	Help pages	• One or more wiki pages dedicated to offering technical guidance on the use of the wiki platform.

Figure 8 - Wiki attributes

Source: Adapted from Lykourentzou et al. (2012)

The attributes for wiki technologies presented in Figure 8, with the simplicity that these technology presents, have made it a unique philosophy regarding knowledge sharing. Unlike others Web 2.0 technologies, that tends to focus on share and broadcast opinion of the individuals, wiki focus more on consensus and collaborative understanding of contexts (Ramos & Piper, 2006). According to same authors, wikis offers significant potential for knowledge sharing and collaborative creation inside the enterprise

2.2.3. Wiki in organizations

The use of Web 2.0 tools in organizations is gradually increasing and gaining acceptance, evidenced by the increasing use of the term Enterprise 2.0, the term refers to use of Web 2.0 tools in organizations (Baxter & Connolly, 2014). According to same authors, these tools enable organizations to interactively communicate and engage with their supplier chain and provide their customer with a sense of empowerment. Analyzing recent studies and their empirical results is possible to note that the main usage for this tools is focused on internal communication and knowledge sharing among employees (Standing & Kiniti, 2011).

Wikis are one of the earliest Web 2.0 tools adopted in organizations for collaboration on software development (Standing & Kiniti, 2011). The same authors affirm that wikis can be used to provide collaboration among widely distributed and decentralized teams, with the same level of collaboration for people local or at different locations. The creation of the wiki contenting used to be bottom-up, across the organization, allowing knowledge being registered and disseminated from operational level to senior management (Stocker, Richter, Hoefler, & Tochtermann, 2012).

Conducting case studies in three different companies, Grace (2009) found many perceived benefits associated with the usage of Wikis. One significant benefit was the ability to save time, such as time saved in training for using Wiki instead of high technological knowledge management tool, time saved in traveling for collaboration, time saved with reduction of e-mails reading and writing. In business terms, times saving equals money saving (Grace, 2009).

Arazy et al. (2009) conduct a unique case study found benefits of the wiki adoption in the organization. Wiki is a generic tool that allows different usage, in the company studied they are using the tool as a document repository, collaboration tool, website development and various other applications. The researchers found that Wiki is perceived as easy to use stimulating employees' adoption, employees that were feeling more proficient using wikis motivates and increase wikis usage.

An important advantage of Wiki use in the intranet is the feature that allows track and revisions. Malicious attempts to misinform can be revised or reversed to the previous version quickly. The edit history can be used by the administration to identify content and users that have created it, avoiding anonymous collaboration and discouraging creation of content that are not aligned with organization policy (Grace, 2009).

Wikis stimulates collaboration between companies, with an asynchronous collaboration the natural flow of the information allows spreading the knowledge construction. This will benefit organizations that are expanding their business, developing collaborative exchange of information from companies in different regions (Payne, 2008). The author affirms that knowledge content from one company can be incorporated by other without need handling staff allocation

The implementation and adoption of Wikis by the organization has some challenges that require being addressed and support from senior management. One challenge is the time to raise the benefits from wiki usage that is not immediate, requiring a period of 1.5 year to achieve a very high degree of adoption among the users (Stocker et al., 2012). Another challenge is that wiki requires a culture of collaboration, this culture can be defined as emphasis on teamwork and group effort rather than individual effort and reward (Standing & Kiniti, 2011).

An active support from the management is an important success factor. When management is doubtful regarding the benefits of the tool, employees are less likely to use it. The support can be provided in different ways, creating incentive tangible or not for employees' adoption. Contribute to wiki page is a task that requires time, so it is crucial management consider as part of the employee work description and not as an extra time (Hasan, Meloche, Pfaff, & Willis, 2007). Standing and Kiniti (2011) argue that one key success factor wikis at Pfizer Inc. were a liberal attitude by management towards individual efforts at fostering collaboration.

McAfee (2006) argue that many of the limitation to use wiki in organizations are about the participation and contribution on pages, the creation of content with quality requires many parts of the organization engaged on that. In some studies case, like European investment bank Dresdner Kleinwort Wasserstein (DrKW), McAfee (2006) found that they created a fertile environment to engage the team in wiki participation, creating, consuming and changing wiki pages. Most of the people on organization are not blogger, wikipedians or taggers, sometimes these people need some incentive to change their roles from reading pages to create and add content on pages

The beginning of the wiki use on organizations is one important aspect and should be planned and executed carefully. McAfee (2006) studying the case DrKW presents the decision that they took to starting the use in the company. The project team decided to an informal rollout and they did not a hard publicity, instead, they encouraging few groups creating wiki pages hoping that the content generated would be compelling enough to draw

people in. With this strategy, people started to use wiki by themselves, going to use wiki not as an obligation but, because there was something interesting.

About the implementation strategy, Grace (2009) after conducting three case studies suggests a framework for wiki adoption. Figure 9 is a pictorial representation of the Wiki adoption process suggested by the author. This framework suggests the implementation of wiki to solve a specific problem or need. Next, the selection and evaluation process is influenced by the organization's information need, this will determine the type of wiki chosen, who will be using it, how secure it should be, proprietary versus freeware, etc. After decided what kind of wiki will be used, an internal wiki could be used as pilot, restricting the use for a specific team. After this pilot, a revision should be done to validate wiki usage, content and success. If the application has reached the planned success level can be promoted to the entire organization, if not, a new pilot with the needed correction can be executed.

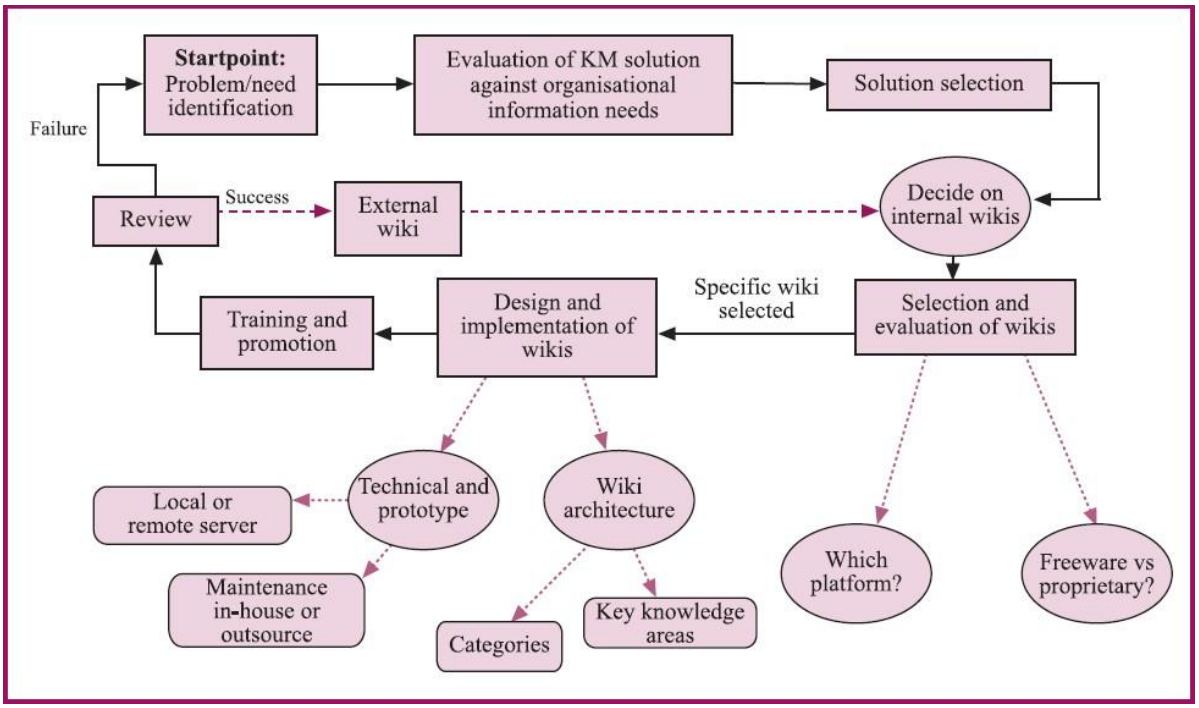

Figure 9 - Wiki implementation Framework

Source: Grace (2009, p. 68)

2.2.4. Wiki in projects

Project management tools were not focused on collaboration, creating a huge onus for project managers that have to collect the information, build and update project plans, communicate changes to team members and report to executives (Filev, 2008). The author presents results showing that execute those activities decreases productivity on all levels in the organization, including senior management. E-mails are used to share communication with team and stakeholders, but many companies argue that collaboration by e-mail produces unnecessary work and delays the exchange of information.

To improve collaboration on projects, Project managers can be benefited by Web 2.0 tools adopted by Enterprise 2.0. Using those tools on projects allows the project manager to share project's information for anyone with an authorized level to access and a device with internet or intranet access (Levitt, 2011). In the same study, the authors add that team members are able to exchange meaningful information, flexibly, directly with each other in real time to make sense of a fast-changing, complex situation

The use of Web 2.0 technologies to manage project is called Project Management 2.0 (PM 2.0). From IT perspective 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; Distributed collaboration is guided by open communication, that thrives on collective intelligence to support decision makers (Kerzner, 2015). The author affirms that PM 2.0 allows getting the information from an entire team including stakeholders and project governance committee. Many projects do not have only one sponsor, having many sponsors with empowerment to interference in many project's goals and requirements. Project managers are expected to have an understanding of governance, stakeholders management and politics. Effective communication skills and tools are required to deal with all those needs (Kerzner, 2015).

About Web 2.0 tools applied to project management, Wikis are especially useful because teams do not need to be in the same place, or work on same time. Wikis can help project's team to organize, track and publish their work, this flexibility helps project managers to have the information right and centered from the beginning (Louridas, 2006). Specifically

on software development projects wikis can be used in different ways, helping the team with several activities (Gholami & Murugesan, 2011). Figure 10 shows the activities that project's team used Wiki pages and how those pages were used.

ACTIVITY	DESCRIPTION
Scope and Task	• Used to define and publish clearly the project's scope; • Issues of scope and task definition were registered and early addressed; • Wiki pages were used to foster evolutionary mindset of all participants throughout the elicitation process; • During the process, each participant must agree with the collective contribution of others stakeholders or negotiate until a consensus is achieved.
Documentation	• Shared repositories of knowledge and documents for all aspects of a project; • Maintains a remote repository for generated documents allowing their modification within a distributed development environment; • Manages versions of a document, with the possibility of reversing wrong changes; • Allows the definition of relations between the various documents that make up the documentation as well as the contents of each of them.
Collaboration and Discussion	• Wikis places each discussion item in its context, which can be easier to grasp than it is in a conventional mail thread; • Many projects use wikis for setting meeting agenda and keeping minutes. This is much more practical than the usual procedure of circulating e-mails soliciting input and comments and then trying to merge everybody's views; • Wiki's collaborative nature encourages negotiation and discussion and aids in achieving consensus and concept consolidation through successive refinements.
Tracking Activities	• Wiki keeps track of changes and incorporate comprehensive versioning and change control for their content.

Figure 10 - Wikis use on projects

Source: Adopted from Gholami and Murugesan (2011)

The use of Wikis on projects are described by different authors on different steps of the project. Share knowledge management is the main application for PM (Gholami & Murugesan, 2011; Standing & Kiniti, 2011; Y. Zhang, Fang, Wei, & He, 2013). However, for any implementation of Wikis, the challenges and difficulties described in section 2.2.3 should be addressed to obtain and successful implementation and a helpful tool for PM.

2.3. RISK MANAGEMENT AND WIKI

This section aims to analyze the literature review presented in this thesis, crossing information and gaps found on literature about project risk management with the characteristic of wiki tool that can help to enhance risk management strong characteristics, apply some risk management's guides steps or cover risk management gaps. In this section, the researcher will present risk management characteristics, strong or weak, wiki characteristics that are related to risk management according to the researcher analysis. Figure 11 shows risk management issues or recommendation and wikis characteristics that can help on risk management issues, or enhance recommendation.

Risk Management Issues/Recommendation	**Author(s)**	**Wiki characteristics**	**Author(s)**
Risk should be identified by different levels on the organization.	(Association for Project Management, 2014); (International Organization for Standardization, 2009).	Wikis are used to gather and disseminate information from/to different levels in organizations.	(Stocker et al., 2012)
Risk can occur due to lack of information.	(International Organization for Standardization, 2009)	Web 2.0 tool enables gather information from many points of view.	(Shang et al., 2011).

Risk Management Issues/Recommendation	**Author(s)**	**Wiki characteristics**	**Author(s)**
Risk identification and assessment are important steps for a successful risk management.	(Project Management Institute, 2013); (Office of Government Commerce, 2009); (Software Engineering Institute, 2010),	Wiki allows gather information from project's team, stakeholders and project committee.	(Kerzner, 2015)
Establish recurrent communication for internal team and stakeholders.	(International Organization for Standardization, 2009; Office of Government Commerce, 2009; Project Management Institute, 2013; Software Engineering Institute, 2010).	Wiki applied on projects allows the project manager to share information for project's team and stakeholders.	(Levitt, 2011)
Some project managers tend to ignore risks when perceives that can create a discomfort on project's environment.	(Frosdick, 1997; Kutsch, 2008)	Wiki's collaborative nature encourages negotiation and discussion and aids in achieving consensus.	(Gholami & Murugesan, 2011)
Project manager's self-efficacy perception can interfere with risk perception.	(Jani, 2011)	Wikis implementation stimulates the culture of collaboration.	(Standing & Kiniti, 2011)
There are problems and difficulties to control identified risks.	(Barber, 2005; Sanchez et al., 2009)	Wiki users can help to organize and track information.	(Louridas, 2006).

Figure 11 - Risk Management issues and Wikis characteristics

An important characteristic for risk management is how the risk is defined, this definition has a direct effect on how the project manager will manage risk on projects (Zhang, 2011). Some of the authors, like Association for Project Management (2014) and International Organization for Standardization (2009), defining risks on their guides highlights that those risks should be analyzed on different organization levels, allowing a wide vision about what can affect the project. According to Stocker et al. (2012), wikis are used by companies to gather information on different levels, being disseminated from operational level to senior management. Using wikis on PM can help the project manager to obtain the risk analysis from different levels, using the collaborative information to receive risk identification from project's stakeholders that acts on different organization level.

International Organization for Standardization (2009) affirms that a risk event can occur due to deficiency of information related to lack of information. The use of a Web 2.0 tool enriches the knowledge enabling to build collective intelligence to gather information from many points of view (Shang et al., 2011). The project manager can use the collective intelligence to obtain as much information as possible to decrease the lack of information and as consequence reduce the deficiency of information.

According to some guides and their authors, like Project Management Institute (2013), Office of Government Commerce (2009) and Software Engineering Institute (2010), identify and assess risks are important steps for a successful risk management. To execute this activity, the authors emphasise the importance of the team and stakeholders participation. Kerzner (2015) affirms that collaborations tools like wiki, allows gather information from project's team, stakeholders and project committee. The wiki usage to identify and assess risks will allow the project manager to identify risks on the project from different levels of hierarchy and, obtain from them the assessment opinion for risks identified by others.

An important activity for risk management is the communication, a recurrent communication about risks status should be established for internal team stakeholders (International Organization for Standardization, 2009; Office of Government Commerce, 2009; Project Management Institute, 2013; Software Engineering Institute, 2010). Tools like wiki applied on projects allow project manager to share information for project's team and

stakeholders with an authorized level to access and a device with internet or intranet access (Levitt, 2011). Adopting wikis the information can be accessible online for everyone with authorized access anytime, the access will permit not only read the information but update when needed and new entries can be created.

Some project managers tend to ignore risks when perceives that talking about risks can create a discomfort on project's environment, risk identification can also create an anxiety stakeholders and team (Frosdick, 1997; Kutsch, 2008). Wiki's collaborative nature encourages negotiation and discussion and aids in achieving consensus and concept consolidation through successive refinements (Gholami & Murugesan, 2011). Grace (2009) suggests wiki implementation on companies in a progressive and evaluative way, that means a specific project or need be covered first and after that, the success of the implementation be evaluated before disseminating the use widely in the company. The application of this implementation scenario can help project managers to introduce risk management concepts environments with risk aversion or anxiety. A project pilot can help to define risk management policies, application and results for a specific group, and this group disseminate risk management concepts for entire company.

Project manager's self-efficacy perception can interfere with risk perception and estimation, tending to underestimate some risks (Jani, 2011). Wikis implementation stimulates the culture of collaboration, this culture emphasizes teamwork instead of an individual effort (Standing & Kiniti, 2011). The stimulation of collaboration culture applied on risk management, can reduce the dependency of one person to evaluate risks events and their consequence, collectively will be possible to obtain visions and consequences from many perspectives.

Although some project managers identify and register risks, there are problems and difficulties controlling them, identified risks are poorly managed and there is not a tool to help a constantly monitoring (Barber, 2005; Sanchez et al., 2009). Wikis enables discussion among their users and can help to organize and track information, transforming the information the center of discussions (Louridas, 2006). The ability to track and centering the information as an important aspect for the team, can allow that not only the project manager is the person in charge to keep risk information up to date, this role can be shared with all team evolved and with stakeholders.

2.4. PRELIMARY FRAMEWORK: ALPHA VERSION

This section presents the first version of the wiki pages framework, the version alpha. This version was elaborated based upon literature review about risk management practices and wiki principles and application on organization and project. Figure 12 shows the framework in alpha version.

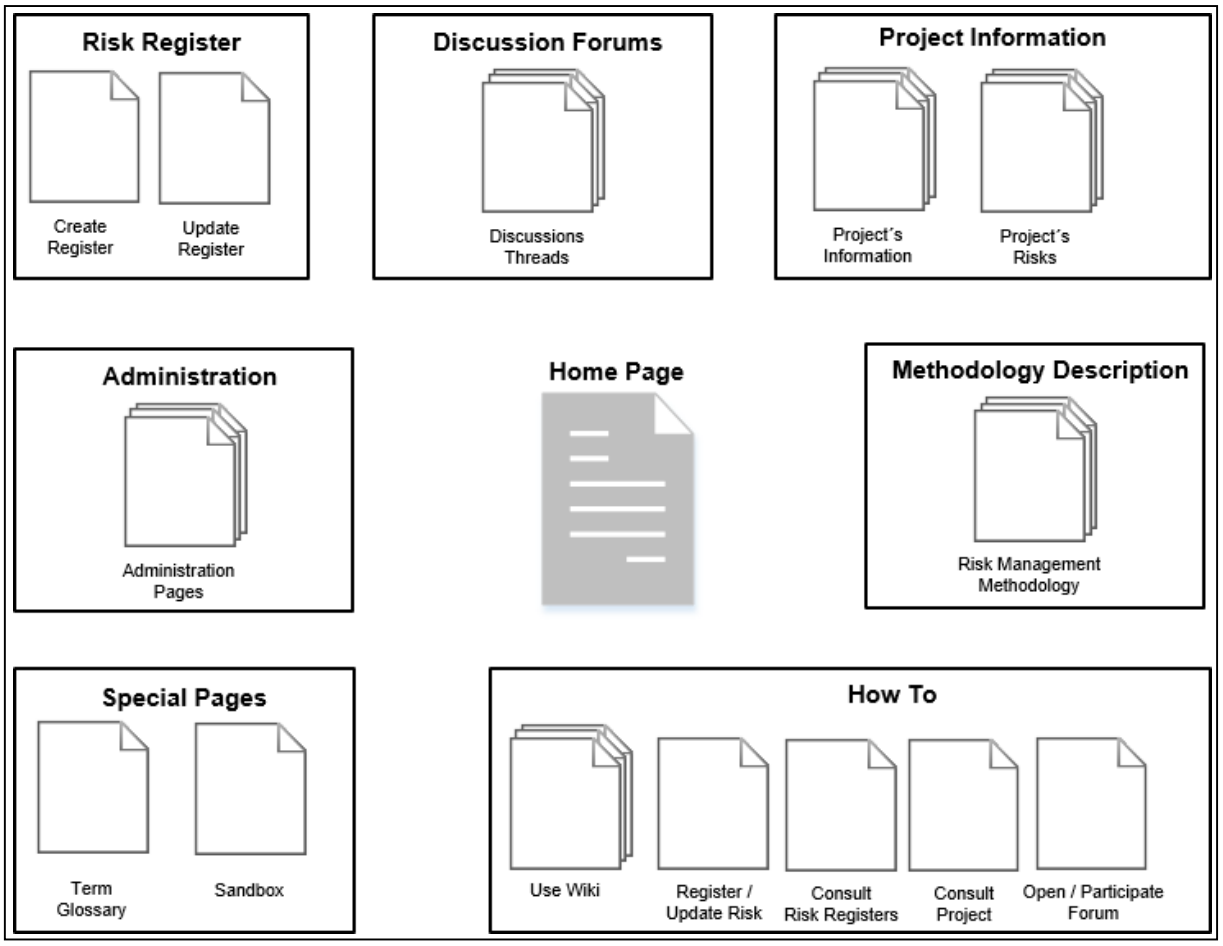

Figure 12 - Framework - Alpha Version

The first page to be accessed is the home page, this page should contain a presentation of the framework and the proposal for risk management. This page should contain a link for

all the others group of pages in the framework. A navigation pane is recommended to allow quick access for users for all the other sections.

The Methodology Description section will contain risk management policies and process defined for the organization. Kutsch (2008) has presented the difficulties to project managers talk about risks with stakeholders, and some projects avoiding to execute the risk management process. A defined and documented policy can help projects manager to talk about risks because they are not talking about something new in the company, and can present the methodology for stakeholders that not know the policy. An accessible methodology can be a helpful tool for project managers executing meetings about risk management and for PMO to publish abroad the company.

The “How To” section contains a guide for beginners’ wiki users. Lykourentzou et al. (2012) recommend the creation of those pages enabling users for a self-learning and self-development to explore wiki pages functionalities. This section should contain how to use wiki and how to open or participate in forums for the very beginners, and them pages specifically about risk management process containing how to create, update and search risks, and how to consult project information.

The Special Pages section can help users to become familiar with wiki pages, the can use sandboxes to training create and update wiki pages without any impact on organization information (Lykourentzou et al., 2012). Those pages can help the adoption of wiki pages for risk management process in organizations and increase participation on the project.

The Administration section can be used for users in charge of administering the wiki pages. These pages should rule about which users can access and what users can do, creating a security level as recommended by Lykourentzou et al. (2012). This access can allow the creation of a group of tests for new functionalities, according to Grace (2009), functionalities can be developed and tested for a small group and, if successful, be promoted for the entire organization.

Risk register section should contain a wiki page for users create new risk registers, retrieve registered risks, change register risks and create new risk register starting from a registered risk. Risk registers on these pages can be linked with one or more projects, can be updated for project's teams and available to be analyzed by any stakeholder with view

permission on wiki. The pages in this section will support steps for register risks and control risks according to the guides reviewed in section 2.1.2.6 of this thesis, covering the risk management steps: Identification; Assessment; Response Strategy; Communication and Control.

Gholami and Murugesan (2011) argue that discussion forums will enable and encourage context discussion, can help to achieve concept consolidation through successive refinements. The authors found that those forums adopted on projects are much more practical to consolidate information than the usual mailing requesting inputs and opinions. The discussions applied on risk management process can be the tool to support project manager on risk management assessment, allowing an open discussion from different levels on organizations.

The Project Information section will store two different kinds of information about projects. The first group of recommended pages is called project's information, those pages will contain general information about the projects. That general information will allow users to identify each project registered, analyzing past project will help for a better context of the project and adopt the information as lessons learned. The second group is the project's risks, used as a consolidation view of the risks registered for a specific project. Those groups of pages will help to monitor risks on projects and be used as a communication tool about risks status according to risk management guides.

3. RESEARCH DESIGN

The research design is a blueprint serving as a plan to be a reference, this logical involves links among the research question, data to be collected and the strategy for analyzing data (Yin, 2011). Thinking carefully about research design, researchers can create a strong platform to develop and validate their studies and address properly data collected to support the research topic studied.

3.1. RESEARCH WORKFLOW

This section describes the workflow used to develop this research, which is illustrated in Figure 13. Each square means a different step with a delimited scope.

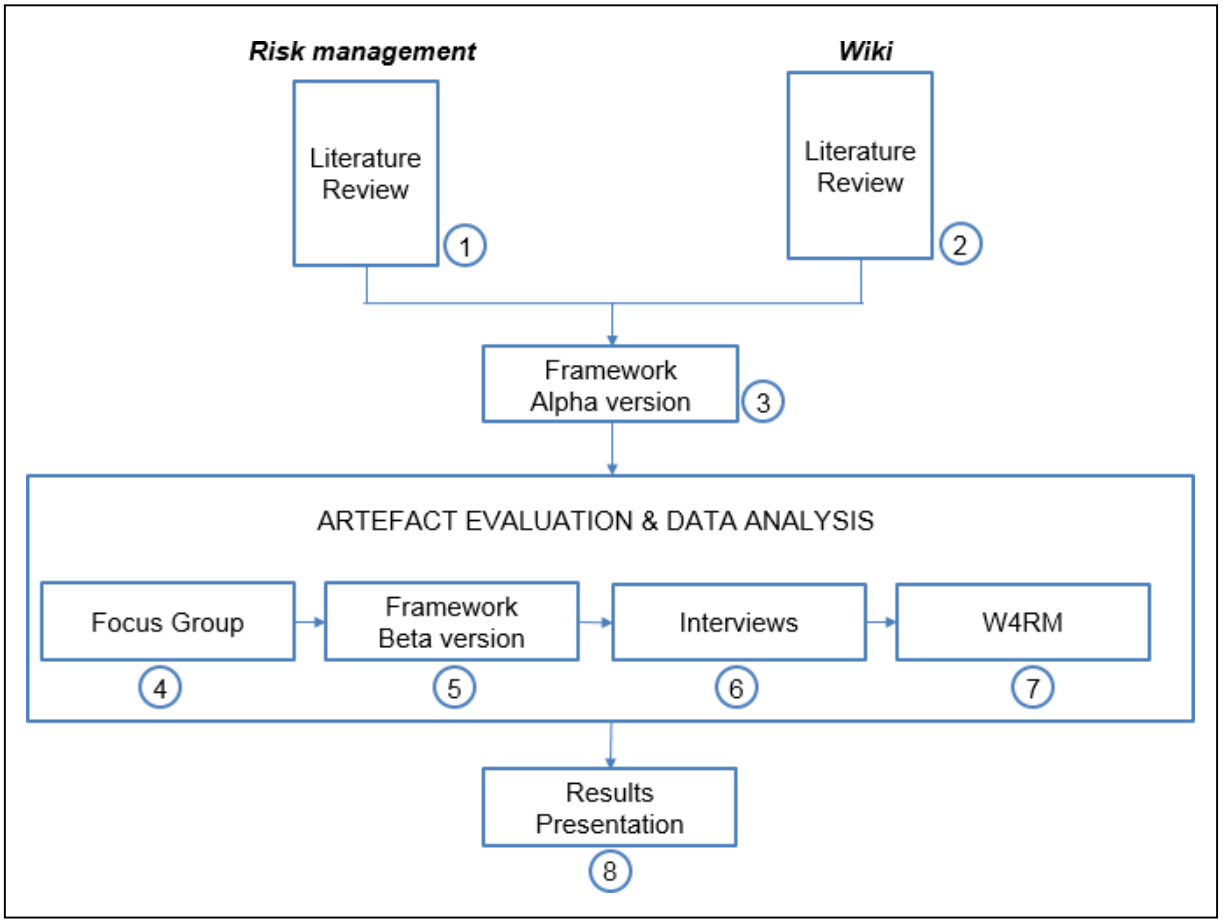

Figure 13 - Research Workflow

The first and second steps for this research were the literature review presented in Chapter 2 of this thesis. The step 1 was the review literature about risk management on

projects, and started with a search in scientific databases like Sciencedirect (www.sciencedirect.com), Scopus (www.scopus.com), Wiley (http://onlinelibrary.wiley.com) and Emerald Insight (www.emeraldinsight.com). The search on each database started with a query ("risk management" and "project management"), reading paper´s abstract and selecting papers for detailed analysis according to the paper´s assumptions. The criteria for selection were paper with risk management definition on IT projects or papers presenting difficulties with risk management on projects.

In step 2, I executed searches on the same databases investigated on step 1. The queries were ("web 2.0" and definition), a second query was (wiki and (organization or company)), and the third query was (wiki and project). The papers returned on the results have the abstracts analyzed and if the content were aligned with the research assumption, with positive or negative aspects, the paper was downloaded for a detailed reading and cited, when used, on the literature review.

According to the literature review, an alpha version of the wiki pages structure for risk management was developed. This structure stores pages containing documentation for each risk management steps defined as recommended in literature. Furthermore, administration pages were added according to literature about access control, views and practices of wikis on organizations.

Step 4 was an exploratory focus group with IT project managers. This focus group was conducted to explore project manager's experience with risk management on past projects, their experience with risk management tools and the success or not of this execution. In this focus group, the alpha version of the framework was be presented to get their opinions, strengths, weaknesses and functionalities to be added, changed or deleted.

Based upon focus group results, the beta version of the wiki pages framework was developed in step 5. This beta version was developed adding o changing characteristics identified as important on the focus group. The size and quantity of changes for this version were not pre-defined at this time, due to the characteristic of a qualitative research, was expected an interaction among participants with discussions, agreements, and disagreements

about the framework. The researcher was responsible for defining which suggestions will or not be adopted.

With the beta version, in-depth interviews were conducted with 12 experienced IT project managers from different countries (Brazil, Mexico and USA). Those interviews aimed gather their experience with web 2.0 tools applied not only in PM but for any professional area. Their experience with risk management tools adoption and their opinion about the wiki pages framework beta version. Those interviews were analyzed to develop the last version of the framework for this thesis, document previous experiences with risk management process adoption, risk management tools adoption and lessons learned about risk management.

A more full-grown version of the wiki pages framework was developed in step 7. This is the version contains characteristics recommended on literature, opinions collected in an exploratory focus group and opinions from experienced IT project managers from different countries about risk management best practices and tools.

In the last step, step 8, the results are going to be presented in Chapter 4 of this thesis. These results contain recommendations about how to develop the framework using a wiki tool, recommended steps for implementation on the organization and expected results. In Chapter 4 is being presented how some other risk management tools can be integrated on process level to abroad risk management.

3.2. METHODOLOGICAL FRAMEWORK

This section describes the research design adopted by the researcher to develop this thesis. It is possible to establish a directional relationship among ontology, epistemology methodology, methods and sources with a rigid connection for each of them. This is possible setting out the relationship among what a researcher thinks can be researched, what we can know about it and how to go about acquiring it (Grix, 2002). Figure 14 shows the directional and logical relationship the key components of the research.

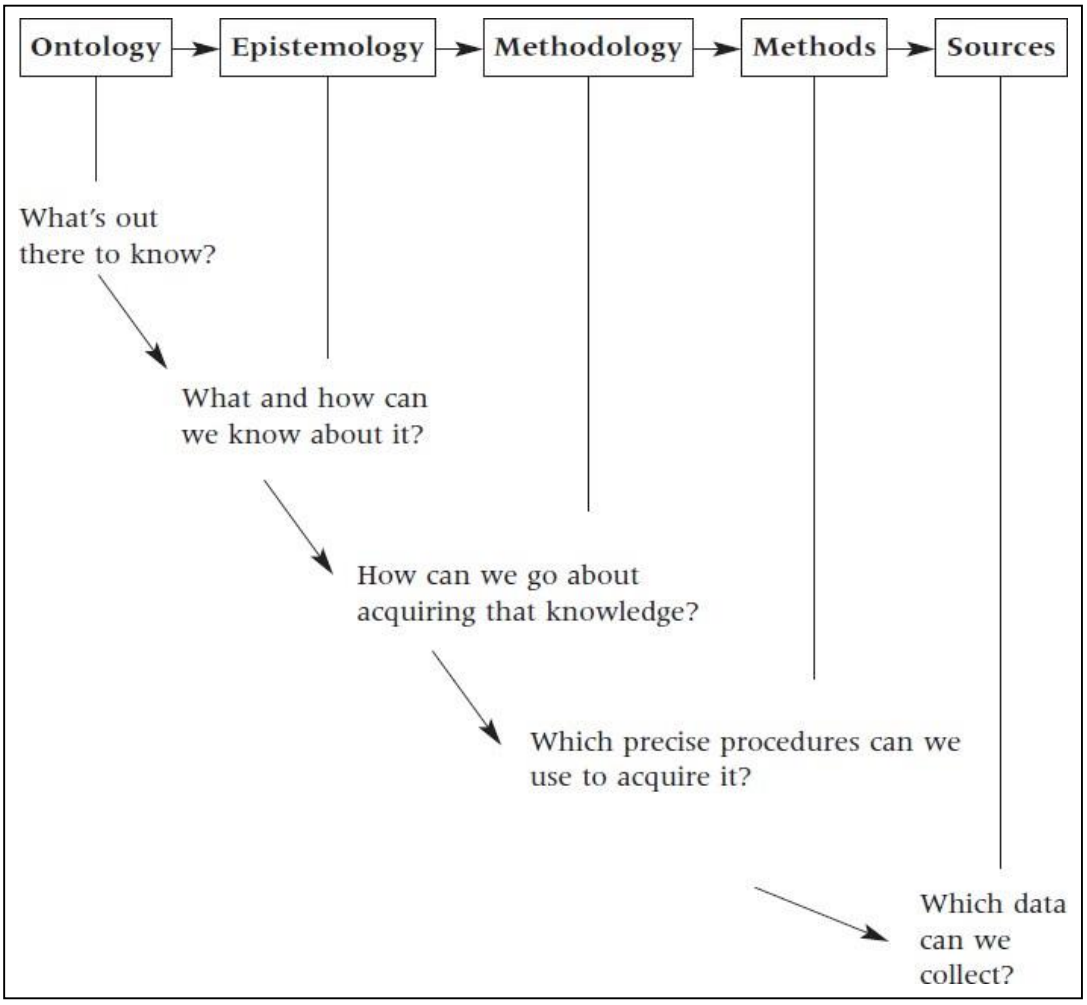

Figure 14 - Research design key components relationship

Source: Grix (2002, p.180)

Based upon the Figure 14, a logical plan was adopted for this research aiming to strengthen the validity of this study and the accuracy of the results. Figure 15 presents the blueprint for the research design adopted. This blueprint is developed based upon the key component identified by Grix (2002), and in this section will be presented each research component adopted and the justification for this adoption.

Item	Value
Ontology	Constructivist
Epistemology	Interpretivist
Methodology / Nature of the research	Qualitative
Method / Data Collection techniques	Focus Group and Interviews
Source / Data Analysis techniques	Content Analysis

Figure 15 - Methodological Framework

3.2.1. Ontology and Epistemology

Ontology is the starting point of a research. Based on the ontology is that epistemology and methodology follows a logical position (Grix, 2002). Ontology can be defined as the study of the conception of reality or the image of a social reality in which a theory is based (Gauthier & Ika, 2012). Define an ontological position means to answer the question: 'what is the nature of the social and political reality to be investigated?' (Hay, 2002). Objectivism is an example of ontological position about reality, with this perspective the social phenomena and their meanings have an existence that is independent of social actors. On the other hand, constructivism is an alternative ontological position, with this perspective the social phenomena and their meanings are accomplished by social actors, where the phenomena have revisions produced through social interactions (Bryman, 2015). Constructivism aims to display a constructed reality through a shared investigation, by researchers and participants, of meanings and explanation (Ritchie, Lewis, Nicholls, & Ormston, 2013).

The constructivism is the ontology adopted in this research, assuming that the phenomena studied have social interaction. The point of view of experienced project managers is an important aspect to be studied and their experience will have a direct impact on the results of this research. Adopting this ontology, the researcher aims to interact with the studied phenomena. The researcher was in direct contact with participants investigating their

knowledge about risk management and web 2.0 tools, their experience executing risk management, their personal opinion about what was successful or not, the reasons for positive or negative results and get advice from skilled project managers about how successful implement a risk management process.

Epistemology is concerned with the theory of knowledge, regarding methods, validation and possible ways of gaining knowledge of social reality (Grix, 2002). Epistemology can be defined as concerned with the nature of knowledge how can be acquired (Ritchie et al., 2013). The main epistemological instances are positivism and interpretivism. Positivism holds that scientific method provides for the acquisition of knowledge through observation and experiment, irrespective of context and related concepts like opinions, feelings, values or cultures (Cibangu, 2010). Positivists view reality and research in terms of links or causality showing links between the selected topic, researched questions, reviewed literature, and chosen methodologies (Cibangu, 2010).

Interpretivism that is being adopted in this research aims to seek an in-depth and context-specific understanding of lived or inner experience or meaning. Interpretivist research question seeks the processes or patterns behind the experiences of a specific group. Interpretivists will use interviews, observation, or ethnography to extract patterned experiences or processes (Cibangu, 2010). Creswell (2012) presents some terms that interpretivists understand and design research:

- Concepts that emerge from collected data or participant's experience;
- Repeated process or patterned relations among chosen concepts;
- Research questions examining the gaps observed in process;
- Observe experience, feelings or views aiming to reach or enact participant's lived experience;
- Context-limited studies or particular cases

This research adopts interpretivism to observe experiences and feelings from participants. Adopting this epistemology, the researcher did direct interactions with each participant aiming to build together a clear picture about his past experience and the point of view of each participant for successful risk management.

3.2.2. Methodology

Research methodology and methods are indispensable for research design, constituting a significant aspect of the research, relating important issues such as data collection, sampling, and data analysis (Cibangu, 2010). There are two major research methodologies, which are quantitative, related with positivism, and qualitative, related with interpretivism. A third methodology, originated from the two major methodologies, can also be adopted, called an integrated method or mixed method that integrate quantitative approach qualitative approach (Teddlie & Tashakkori, 2009).

This research is adopting qualitative research, which enables the researcher to conduct an in-depth study about a broad array of topics, offering a greater latitude in a selected theme to be researched (Yin, 2011). Denzin and Lincoln (2005) present a definition of qualitative research and their nature from social construction:

> "Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretative, material practices that make the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings and memo to the self. At this level, qualitative research involves an interpretative, naturalistic approach to the world. This means that qualitative researches study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them." (Denzin & Lincoln, 2005, p. 3)

A qualitative research should be conducted when the researcher needs a complex detailed understand of the issue. This detail can be established with a direct contact with people, going their home or places of work (Creswell, 2012). A qualitative method provides kinds of information and understanding needed in social research, it is useful to consider some extensive functions of social investigation (Ritchie et al., 2013). Yin (2011) presents five important features of qualitative research that can be considered by a researcher as reasons to adopt this method. The features are:

- Studying the meaning of people's lives, under real-world conditions;
- Representing the views and perspectives of the people in a study;
- Covering the contextual conditions within which people live;

- Contributing insights into existing or emerging concepts that may help to explain human social behavior;
- Striving to use multiple sources of evidence rather than relying on a single source alone.

3.2.3. Method / Data Collection Techniques

When researchers are defining a method, they should bear in mind that any of chosen method should be free from ontological and epistemological assumptions, and the researcher's choice should be guided by the research question (Grix, 2002). On qualitative research, a decision should be taken about how to collect data, considering the context and structure of the research, with a key distinction between data naturally occurring or generated data (Ritchie et al., 2013).

Generated data requires from researcher attitude to obtain re-processing, re-telling of attitudes, beliefs, behavior or other phenomena experience (Ritchie et al., 2013). Generated data give insights into people to obtain their perspective and interpretation of the meaning that they attach to them. The use of an appropriate method to generate data allows obtain from participants their motivations, beliefs, decision process and cause some participants´ reflections about the social phenomena to be gained (Ritchie et al., 2013). The authors recommend some methods as appropriate to obtain generated data, such as biographical methods, individual interviews, paired interviews or focus group.

For this research, focus group and individual interviews were adopted as the technique to collect data. Using data side-by-side collected from interviews and focus group can set rich complimentary findings contributing to a more nuanced and comprehensive understanding (Lambert & Loiselle, 2008).

3.2.3.1. Focus Group

Focus group provides a social context for research and an opportunity to explore how people think about a topic, how their ideas and process decisions are shaped through a conversation to the others (Ritchie et al., 2013). This method can help participants to express

themselves when they are part of group (Yin, 2011). Group discussions allow participants to hear from others, providing an opportunity for reflection and for direct and explicit discussion of differences of opinions and beliefs. This participant discussion can trigger additional material and information in response in what they hear, asking questions, clarification and individual response becomes refined and sharpened (Ritchie et al., 2013).

For this research, a focus group was used to explore project managers´ experiences managing risks, encourage discussion among participants about best practices, difficulties and recommended steps to be done by project managers. The group was formed by seven participants, all participants are project managers with experience in IT projects. By convenience, have been chosen participants who live in São Paulo area, so all participant could attend focus group meeting at Nove de Julho University headquartered in São Paulo. Figure 16 shows the participants´ profiles and their experience on PM.

ID	Age (Years)	Project Manager role experience (Years)	Work as internal project manager or service provider?
FG01	36	06	Service Provider
FG02	53	03	Internal
FP03	43	13	Service Provider
FG04	50	16	Internal
FG05	33	11	Internal
FG06	30	06	Internal
FG07	48	23	Service Provider

Figure 16 – Participants' profile in the Focus Group.

In the meeting, the researcher assumed the moderator role. Assuming a moderator role on focus group meeting, the researcher restrains or preside over a meeting and should be a facilitator to assist the progress of a process (Ritchie et al., 2013). During the meeting, the

researcher applied the protocol presented in Appendix A. For each question, all participants were instigated to opine and, sometimes, participants agreed and disagreed each other creating an enriched discussion. The meeting lasted 110 minutes, including two presentations about web 2.0 tools and framework presentation done by moderator.

The questions about risk management difficulties were applied in order to allow the researcher compare aspects found on literature review and aspects listed by participants describing their ordinary activities managing risks in IT projects. Applying the questions about risk management processes, the researcher aimed to find if there are some particular step done by one or more participants that were not found in the literature review. Those questions aimed to verify how the participants execute the steps found in literature.

About the framework, the alpha version was presented to obtain their opinion about it, identify its strengths and weaknesses and ask inputs about what could be changed. This discussion aims to obtain different points of view, identifies assumptions that are unanimous in the group and assumptions that can split project managers´ opinions. When was did the framework presentation, the moderator made explicit that the framework was found in a literature research, and not as his own development. The intention of giving the framework authorship for an unknown person was to avoid participant bias that would not criticize some negative aspect due to be with the author in the room. Only in the end of the meeting, the moderator has identified the framework as developed by himself, based on literature research.

3.2.3.2. Interviews

Individual interviews as data collection method, provide an opportunity for detailed investigation of individual's perspectives, for in-depth understanding of the personal context about research phenomena (Ritchie et al., 2013). Qualitative interviews aim to understand participants on their own term and how they make meaning of their own experiences and cognitive process (Brenner, 2006). This approach assumes that when a researcher formulates a question participants will express their experiences that will reflect their reality (Sandelowski, 2002).

The number of interviews for this research was not be pre-defined, new interviews were done until data saturation. The concept of data saturation in qualitative research entails adding new participants to the study until the data set is complete, and data collect become replicated or not redundant (Bowen, 2008; Marshall, Cardon, Poddar, & Fontenot, 2013). For this research was interviewed 12 participants to reach data saturation, with this number information and opinions started to repeat.

Figure 17 shows their professional skills and Figure 18 shows the country where they live and work and their company industry.

ID	Age (Years)	Project Manager role experience (Years)	Work as internal project manager or service provider?
IN01	51	15	Internal
IN02	47	11	Internal
IN03	48	11	Service Provider
IN04	36	8	Service Provider
IN05	44	14	Service Provider
IN06	45	18	Service Provider
IN07	52	18	Internal
IN08	51	15	Internal
IN09	38	10	Service Provider
IN10	31	3	Service Provider
IN11	35	6	Internal
IN12	58	21	Service Provider

Figure 17 - Interviews Participants Profile

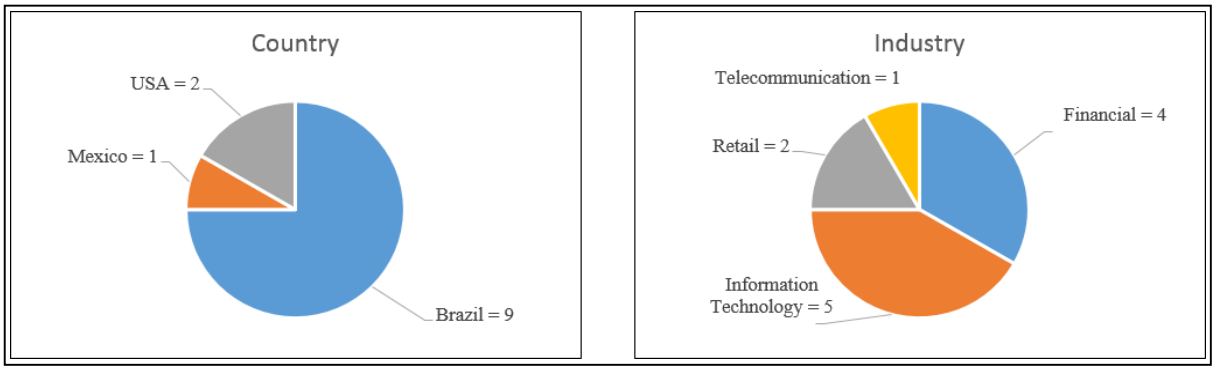

Figure 18 - Interviews Participants Details

The criteria to choose participants was project managers with risk management experience and Portuguese or English speakers. In order to reach abroad participant´s point of view, the researcher invited two people from the USA and one person from Mexico to participate and contribute with their perspective. Regards the industry sector, this research contains respondents from four different industries. Adding participants from multiple industry sectors can avoid any bias from one unique sector.

All interviews were done via Skype and recorded using MP3 Skype recorder, all respondents allowed to record their interviews. To transcript the interviews was used the software Express Scribe Transcription. For Brazilian speakers, the interviews were in Portuguese and, after the transcription the results were translated to English. For Americans and Mexican, the interview was in English.

3.2.4. Data Analysis

Content analysis is a research technique for making replicable and valid inferences from data to the respective context (Krippendorff, 2012). Content analysis is the replicable and systematic examination of communications and their symbols, the analysis of relationship involving values attributed to symbols using statistical methods to describe the communication, draw inferences about its meaning or inferences from the communication to its context (Riff, Lacy, & Fico, 2014). Despite there is no systematics rule for analyzing data,

the key feature for content analysis is that words in the text are classified in smaller content categories (Elo & Kyngäs, 2008). Figure 19 shows the three main phases, preparation, organizing and reporting, for an effective content analysis.

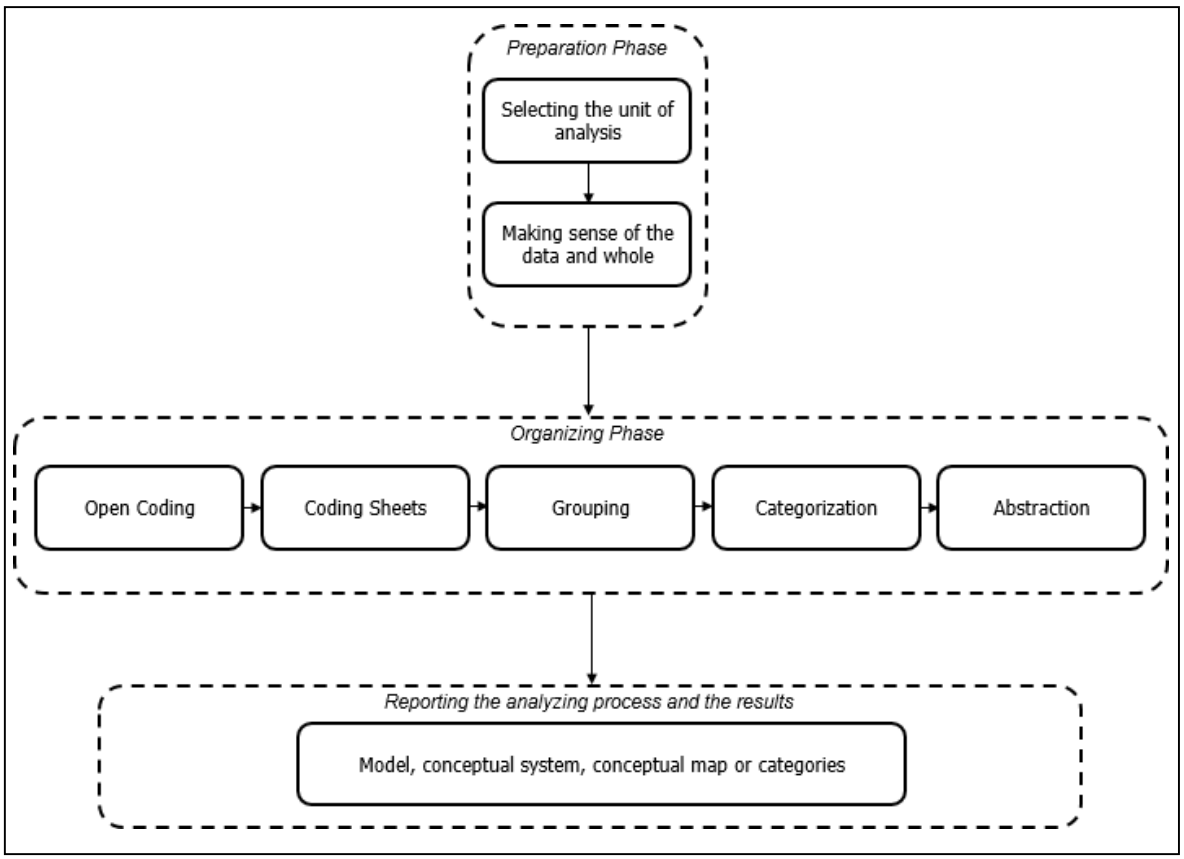

Figure 19 - Content Analysis Workflow

Source: Elo and Kingäs (2008, p. 111)

Preparation phase is composed of two steps. The first step is about selecting the unit of analysis that can be a word or a theme. Next, is make sense of the data, the researcher needs become immersed on the data, this is an important step because no insights or theories can spring forth from the data without the researcher becoming familiar with it (Elo & Kyngäs, 2008).

The organization phase on qualitative data is composed of five steps. Open coding means that headings and notes are added to text while reading, adding as many as necessary to describe all aspects of the content (Hsieh & Shannon, 2005). After that, in the second step, the

headings are collected onto coding sheets and freely categorized at this stage (Elo & Kyngäs, 2008). After the free coding, headings are grouped under the higher group heading aiming reduce the number of categories, groups similar headings. Finishing heading groups, in the fourth step, they are collapsed in categories, the purpose of the creation of categories is to provide a means about the phenomena and improve understand and knowledge. The last step in this phase is the abstraction, that means to formulate a general description of the research topic for each category (Elo & Kyngäs, 2008).

The results of the process, described on the third phase, should be in sufficient details to allow readers have a clear understanding of how the research was carried out. A content analysis successful requires that the researcher can present a simplified data after an analysis in a reliable manner, to improve the reliability of the study, it is mandatory to demonstrate a link between the data and the results. Tables and appendices and can be used to demonstrate links between the results and data (Elo & Kyngäs, 2008).

To analyze the results, I used MAXQDA and Excel. MAXQDA was used in part of the analysis to encode the transcriptions and finding repetitions and groups of citation. Excel was used to group and categorize data.

4. RESULTS: ANALYSIS AND DISCUSSION

To present the results, this chapter will follow a sequence presented in Figure 13, from step 4 to step 8. The content analysis described in Figure 19 was executed twice, the first time was to analyze the focus group analysis and the second time to analyze the interviews.

4.1. FOCUS GROUP ANALYSIS

The objective of the focus group was to collect feedbacks and insights from IT project managers regarding the framework alpha version. The mediator of the focus groups stimulated participants to share their experiences on risk management in IT settings and to give their opinions regarding the proposed framework. As one participant commented on the hindrances they face on the process of risk management, the mediator would ask others to say if they agreed or not with those statements.

Besides, the mediator aimed to collected information on how the participants dealt with risk management and information about the procedures they conducted to identify and monitor risks in their projects. For instance, one participant said that he uses an Excel spreadsheet in which the registers risks he identifies during the project execution. He affirms that some of these risks are not reported to other people involved in the project. He names this spreadsheet as a "secret list". Other participants, then affirm, that they also have a "secret list". The following excerpt of the conversation shows how they use spreadsheets to monitor risks:

[FG04]: I usually have a spreadsheet in which I write a list of risks that I cannot show to anyone in order to avoid political problems. For example, I worked in a project in which a project member didn't conclude any of his tasks on time due to work overload. I knew that, but I couldn't report the work overload because this put me in trouble with the manager of this project member.

[Mediator]: Does anyone else have a "secret list"?

[FG03]: I do not publish some risks due to political reasons. There are some operation managers that feel personally offended when I report any risk or problem related to them or to their teams.

[FG06]: When I identify a risk, I verify if it is related to some managers with whom I cannot have problems in the future. If it is, I have an informal conversation with the manager instead of reporting the risk.

[FG07]: There are certain risks that I cannot report to our customers.

The script of the focus group was divided into four main topics. The first topic was about difficulties that managers facing during the process of risk management. The second referred to how IT project managers conduct risk management. The third topic intended to grasp participants' knowledge on Web 2.0 tools. The fourth topic aimed to collect participants' feedbacks and insights about the framework.

4.1.1. Barriers and issues on risk management

In the first part of the focus group, participants talked about the difficulties and issues they face on risk management. For example, they cited some resistance from members in the organizations. I grouped the issues reported by participants into five categories. Following, I describe these five categories:

Lack of feedback

This category involves the difficulties on getting feedback from project team members, stakeholders and project sponsors. Even though project managers try to get team members, stakeholders and sponsors involved in the process of identifying and monitoring risks, they ended up working on these activities by themselves.

[FG05]: I set meetings to discuss risks with the team. However, after a while, it´s impossible to receive any status of how team members are dealing with those risks.

[FG07]: At the beginning of the project, the team accepts to cooperate in the process of monitoring risks, but during project execution it is very difficult to get their attention and effort to work on that.

[FG04]: I send a risk status report every week, but I update this report by myself. I don't get help from anyone.

All the participants agreed that project managers are the only ones in charge of keep the status of risks updated. As they discussed the issues they face on risk management, participants admitted that most of the time, project managers do the whole process by themselves: they create the risk management plan and assign task within team members, but the team does not engage in the process as expected.

Lack of support from project sponsors

When project managers try to present risks to project sponsors, these sponsors usually do not want talk about or to address these risks. According to the participants of the focus groups, sponsors usually ignore the risks, even though these risks are constantly reported in the PM plan and on project meetings. The resistance from sponsors is such that project managers feel uncomfortable on reporting risks. Participants confessed that sometimes they even delete risks from PM plans.

[FG03] Some sponsors just refuse to talk about risks. The term "risk" just scares them.

[FG04] Sponsors with technical skills discuss risks, but sponsors from the business area do not want to talk about risk.

Contingency Costs

One of the consequences of the lack of support from project sponsors is that project managers get hands tied as they try to elaborate a contingency plan to minimize costs. As risks are poorly addressed and monitored, project managers cannot reserve resources for contingency costs.

[FG07]: After finishing project plan with the team, I did a presentation to sponsor explaining the risk and requesting a budget for contingency plan. The sponsor said that I was increasing project costs and didn't approve any reserve for contingency costs.

[FG04]: In the company I work at, suppliers are challenged to reduce project costs. But sometimes theses cost reductions are not feasible. When a sponsor spends less than the budget reserved for that project, he/she receives a bonus. For this reason, when I try to reserve an amount of money for contingence, sponsors do not approve, since they want to reduce costs as much as possible so they can get a bonus. Because of this bonus policy, sponsors tend to ignore the fact that when unexpected problems occur, costs are higher.

Project managers' lack of credibility

One important fact that can inhibit project managers from talking about risks is their (lack) of credibility in the eyes of those involved in the project. Participants said that when they try to talk about risks, they can sense that some people judge them as incapable of accomplishing project goals. In order words, for some people, when project managers report risks, they do so in order to justify future failures.

[FG01] Once I identified a risk that would have a huge impact on the project. Then, I requested a team meeting to talk about ways to deal with that risk. During the meeting, someone said that I was being pessimist. Some team members agreed with him and, as a result, that risk was bypassed. Unfortunately, that problem happened as I predicted. We had to work a lot to solve that issue. I felt that some team members remembered that meeting, but they never admitted I was right.

[FG07] In some occasions, a project manager can lose his/her teams' trust by talking about risks. People may think that you are not confident or competent enough to manage the project well.

Partial risk management

According to focus group participants, project managers are led to choose to manage risks in only some projects. When organizations do not have a standardized policy for risk management, project managers use their experience and feeling to choose which projects demand risk management. They use a kind of rule of thumb. Usually small projects do not demand the implementation of risk management. Risk management is more necessary in large and complex projects.

[FG02]: The first factor I consider when deciding to manage risks or not is the project team. If I have a team that is resistant to talk about risks I prefer to avoid talking about risk management.

[FG07]: My decision is based on project cost and the technology to be adopted in that project. For a project with minor costs and with known technology, I prefer not engaging on risk management.

[Moderator] Why do you choose ignoring some risks?

[FG07]: The difficulty in talking about risks sometimes is so big that it is better to deal with the problem when it occurs.

[FG03]: I try to execute risk management in all projects, but sometimes team members or sponsors just do not want to collaborate. In these cases, if a problem occurs, we change the scope of the project.

4.1.2. Risk management process

The questions presented in this section aimed to find how project managers conduct procedures on risk management. These questions are presented in Appendix A. One of the questions was open and aimed to get opinions from participants on the activities to manage risks on their projects. As I asked this question I tried to let participants confortable and free to give spontaneous and sincere responses. As I analyzed the content of these answers I concluded that most of participants do the activities Section 2.1.2 of the literature review. Another important finding on my analysis was that project managers tend to conduct procedures on risk management only partially. I concluded that professionals adopt the practices instructed by PMBOK® and ASAP from SAP.

Participants affirmed that even though they do their best on using best practices and methodologies of well-known PM associations, they realize that organizations are ready and willing to fully implement risk management. For participants, one possible reason for this scenario in organizations is that Brazilian culture presents resistance against talking about controversial themes and confrontation.

[FG06]: In my organization, we are trying to adopt the SAP the methodology called ASAP which is used on ERP implementation. I don´t know if this is the best PM methodology but fits to organization's needs better than PMI.

[FG01]: In my organization, we adopted ASAP only for the ERP project. For other projects, we were adopting part PMI best practices. What I'm used to do is to identify and analyze the possible problems on projects. However, we unfortunately don't monitor risks as we should.

[FG04]: In my organization, any risk report cannot have more than three lines. Directors simply ignore all long reports. So, I try to adapt risk management according to the culture of the organization.

[FG05]: In my organization, managers see risk management as an activity that finishes at the end of the project, and so they never register risks for future use. There is not a risk repository which is an important activity to manage lessons learned in organization. Unfortunately, this initiative is ignored.

In the focus group script questions 7-10 addressed project mangers' attitude regarding risk management.

Risk Identification

For most part of participants, risk management is an activity that conducted by project managers themselves. It is known that discussing risks with project team members enriches and improves risk management, participants admit that they tried to engage their teams on this initiative but without success.

[FG04]: I use my experience to generate a risk list. With this list in hand, I talk to ask my team individually and ask for their opinion.

[FG02]: I talk with other project managers before generating a risk list. Then, I improve this list by talking with each one of the team leaders involved in the project.

[FG06]: I use an Excel file with some questions about risks to interview team members individually.

[Mediator]: Why do you have conversations individually?

[FG04]: In my organization is very difficult to talk about risks, so I talk with them (team members) about potential problems.

[FG06]: My authority as a project manager is zero, so what I can to try convincing them (team members) to talk about risks via e-mail.

[FG03]: In my organization, I have meetings to talk about risks with the team. It´s difficult to have the whole team engaged in the process. To identify risks, I ask about the individual activities of team members.

Risk Evaluation

Project managers conduct risk management as set parallel activities. Participants affirmed that they usually identity and evaluate risks at the same time. Basically, all information on risks originates from project managers' experience and team members' opinions.

[FG01]: I have a template for risk lists. Then, I get information about impact and probability of risk. I prefer to do that by myself than with my team.

[FG03]: Sometimes the individual that identifies the risk doesn't know the impact or probability of that risk. In this case, I give my opinion and then, get his/her validation.

[FG07]: Due to past problems, I get risk inputs only from the individual who identified the risk.

[Moderator] What kind of problem you had?

[FG07]: When I asked for a second opinion from a guy from another team, the consultant that identified the risk thought that I didn't trust his opinion. This happened with a couple of times. For this reason, I don't get opinion people anymore.

Risk Communication

Risk communication was the theme in which participants have more distinct opinions. Each participant had his/her own way to communicate with their teams. I could see that every project managers develop their own way to communicate risks. Some participants revealed they do not report all risks they see. Some of these risks are registered in a private document that others cannot access. Other participants affirmed that they use portfolio management tools like CA Clarity. When project managers do not use a PM tool they use spreadsheets and e-mail to communicate risks. There is not a specific or unique template for risks report. Participants said they adapt the way they report risks according to their audience.

[FG04]: I have tried to report risks in different ways. I have used e-mails, I have created a risks list and sent to project team members, and I also have set report meetings.

Using graphics was the most efficient way to motivate team members to get involved in risk management. Then, when it is necessary, I have individual conversations among the members of my team.

[FG06]: I have two different reports. One report for risk management which contains a synthesis of the risks identified in the project, and another report directed to the technical team with more technical details.

[FG02]: In my organization, we use CA Clarity to register risks. But before registering any risk, I talk to the person to whom I will assign as responsible for that risk. I give him/her some recommendations on how to monitor that risk. I do that because I have had some misunderstandings with some coordinators who felt uncomfortable when I reported a risk assigned to their teams without previous conversation.

Risk Monitoring

According to participants, the activity of monitor risks is exclusive to project managers. They admit that project managers should not be only ones responsible for monitoring risks. However, monitoring risks is something that few people time or willingness to do. People only report on risk when they are asked or demanded to do it.

[FG05]: I never received a feedback about risk from team members neither from sponsors.

[FG04]: Me neither.

[FG05]: I keep my risk list and I am responsible for updating it. I never got any update from the team.

After getting opinions about risk management activities and discussing the activities of identifying, evaluating, communicating and monitoring risks, the mediator started a discussion about what participants thought about the role of the project manager on risk management. This discussion also focused on implementation of group work. Project managers understand that the process of risk management should not be centered only on themselves. Surely, project managers expect to get collaboration from all team members, especially on activities of monitoring risks.

[FG06]: After risk management plan is finished, it would be perfect to see that information shared with the whole team. If that happens, the project manager would have a mediating role, by solving specific problems, clarifying doubts about the process, or getting approval for contingence funds.

[FG03]: It would be great to have an input from the team right after reporting a new.

[FG01]: I feel that people are not motivated to participate. When a new employee arrives in the organization, he/she gives suggestions and opinions very enthusiastically. But as times goes by, his/her motivation diminishes such as his/her participation on report meetings.

[FG04]: Sometimes is not lack of motivation, there are some team members that work in three or four projects at the same time, and then they have no time or energy to grasp a more holistic perspective of the project. They just do their jobs and go to next project.

[FG02]: A good risk management process should think in opportunities.

4.1.3. Web 2.0 tools

This section of the focus group aimed to find out how much participants knew about Web 2.0 tools and their opinion on using Web 2.0 tools on risk management. After the mediator shared some definitions on Web 2.0 technology, participants were invited to list tools they use or know. All participants use Facebook, Twitter and WhatsApp on their free time. Some participants create groups in WhatsApp so they can share information and notification about the project. Another participant was planning to adopt WhatsApp as an official channel for project communication, but since the organization could not afford cost with cell phone bills and since the organization fear to get problems with labor charges, this initiative was disapproved.

[FG05]: I was planning to adopt WhatsApp in my organization, but only managers have corporative mobile phones. The Human Resources (HR) department has no information about the legal implications on sending corporative messages to employees' mobile phone. When I asked for that information, they didn't try to find alternatives. The HR department only informed that I shouldn't create groups in WhatsApp for corporative purposes.

Participants listed other Web 2.0 tools that they know and use for personal purposes. When the mediator asked about other Web 2.0 tools they use (or would use in organizational settings), they mentioned some tools developed internally by the organizations, wikis and Trello.

[FG01]: My company uses wiki worldwide to keep discussion forums, knowledge base and software communities. However, in Brazil, only a few numbers of people access and collaborate.

[FG07]: We use Trello to create a project plan, assign activities and share some project files.

[FG06]: My organization has developed an in-house tool of corporative social media. We register the strategic plan of all projects in this tool, but this tool doesn't help on managing projects because there's not any function related to project management such as project schedule or project baseline.

[FG03]: There's an in-house tool in my organization, but few employees have adopted it in their daily activities. To encourage the use of this tool, the organization has established bonus policy. This initiative has proved to be inefficient. People only use the tool during the weeks that precedes bonus payment: everyone starts adding past information in the tool only to create "volume". But they don't worry about the accuracy or validity of that information.

4.1.4. Analysis of preliminary framework: Alpha Version

The last section of the focus group was focused on analyzing and discussing the framework proposed on this research. This section started with a detailed presentation of the current version of the framework. As discussed in Section 3.2.4.1, the mediator said that the framework was developed by another researcher, and that the present research aimed to adopt this framework. The mediator emphasized that participants should analyze and comment on that framework.

Participants then affirmed that one of the goals of the framework should be the knowledge sharing and dissemination. According to participants, this framework should involve tools that would collect opinions from experts so that this knowledge would be

accessible to everyone in the organization. Participants also said that the framework could be used by managers and executives to encourage employees to participate on decision making and knowledge creation.

[FG06]: When there is a specialist with an exclusive knowledge about an important aspect of the project, this tool should collect this knowledge so that when a new employee could access this information.

[FG05]: The framework could be used to encourage stimulating discussions about risks.

One important aspect discussed by participants was how this framework could help creating a corporative risk management culture. For participants, this could not be done by implementing the framework. From this point of view, PMO should be in charge of the project, starting risk management process with directors and managers.

[FG03]: During our discussion, I was thinking about a problem we face regarding on my team: my team doesn't participate in the process of risk management at all. We need to encourage them to participate. I believe this framework can help increasing the collaboration within team members and creating an appropriate environment for employees to participate on risk management.

[FG04]: Nowadays there is no a discussion about the process of risk management. We ask inputs for risk identification, but we are not changing the culture, we are just registering risks. This tool as social media can enrich the process capturing suggestions. Using wiki to write the process can show that the process is alive and can be improved.

Another aspect debated by participants was the role for project manager when the framework is adopted. Participants agreed that project manager role can be changed, 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.

[FG03]: The project manager has the function of communicating all the conflicts. When you are the person communicating a conflicting opinion, for the other, you are the one with that opinion. Creating a forum for that, the opinions are registered with his owner.

[FG05]: Project manager will not be in the center of everything. Risk responsible is communicated for everyone, and when an event monitoring fails, the project manager will not be the unique guilt for the sponsor.

[FG02]: Not only the project manager needs to be the mediator. Another people in the team can mediate. There are many people that like to participate in internet forums, this kind of profile can be used in companies to improve social media adoption.

Not only positive aspects were discussed by participants, in their opinion, the user's adoption will be a big challenge for any Brazilian company. Collaboration culture is rare in Brazilian corporative environment. Although many people are hard users of social media like Facebook and Tweeter, they are uncomfortable to write in corporative forums. The company that decide to implement this framework needs first create a campaign about how to collaborate in the corporative wiki, explaining ‘do’ and ‘don´t’ in this environment. After that, during all framework implementation and post-implementation new communications campaign should be done aiming to increase the number of adopters.

[FG01]: Adopt this tool in Brazil will be a huge challenge; the company needs to find ways to stimulate participation.

[FG06]: Will not be easy gain participation. Human resource campaigns need to be done before project starts, during project implementation, and after implementation. Without that support, the team will not feel confident to collaborate.

[FG04]: Everyone needs to understand what can be written in the corporative wiki. An employee can be fired if write something not adequate to the company.

The last question of the focus group meeting was a request for inputs about the framework, asking what participants would add or remove from the framework. The participants did not suggest to remove anything, their collaboration was about how the data stored in this repository could be consumed by external tools and how the data could generate reports.

Based upon the inputs, the beta version was developed. Figure 20 shows this version, containing the external access layer, comparing alpha and beta version, the beta version has all alpha version content plus external layer.

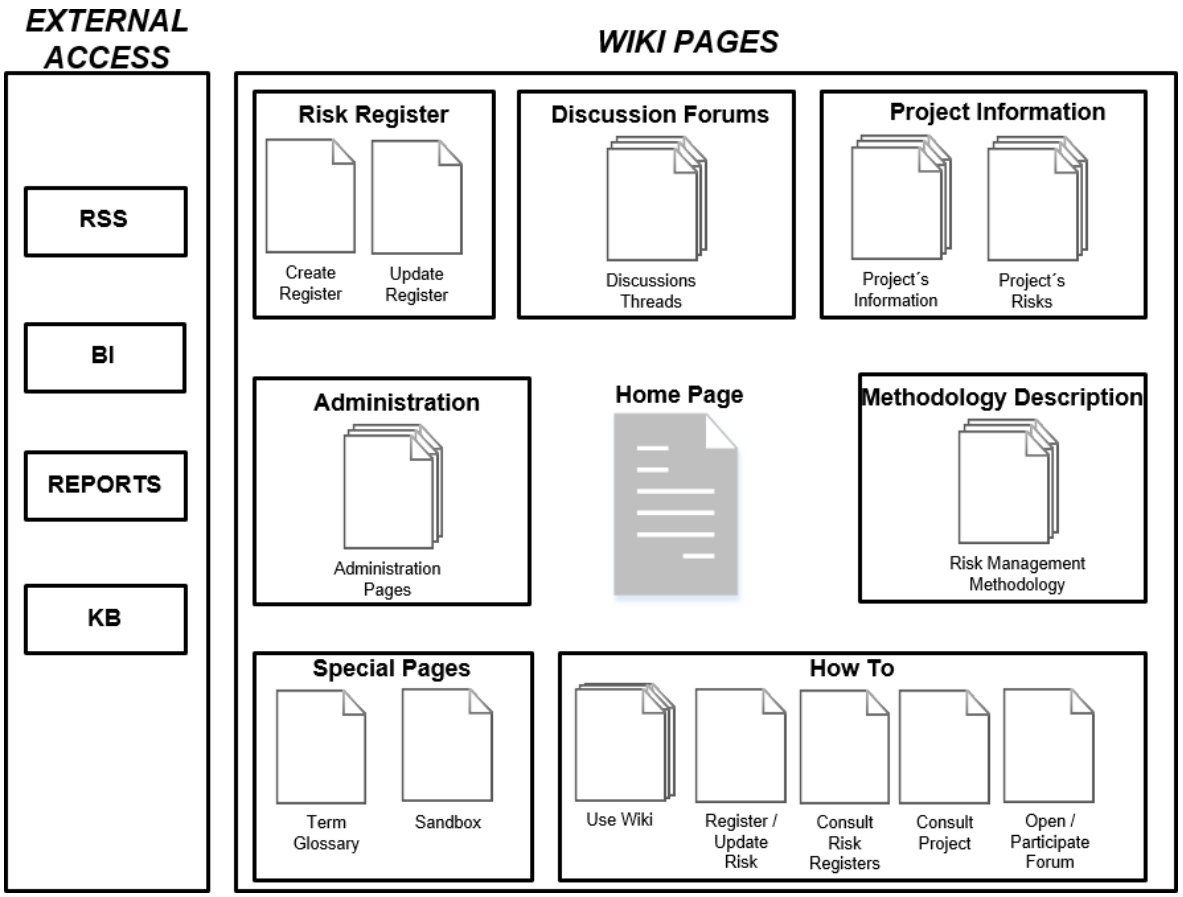

Figure 20 - Framework - Beta Version

Considering that all the content on wiki pages framework is presented in Section 2.4 of this thesis, this section will discuss the additional data located on External Access layer. Focus group participants have emphasized the importance of integration among the framework and external tools to enable reminders, alerts, reports and corporative knowledge base. A robust tool cannot exist as an isolated tool and should be the source for others, permitting data comparison, data complements and corporative views.

The adoption of a Really Simple Syndication (RSS) will enable alerts for framework users. Using RSS the user can monitor a content or changes in a specific page, for example,

after adding a new risk the user can create an alert on RSS to monitor any change on the page, this alert can be sent by email or an RSS service called aggregator.

[FG05]: You can use RSS to create alerts and monitor some themes. For example, you can monitor any Risk added or updated with some specifics tags like Political, Management etc.

A Business Intelligence (BI) tool access and consume data from the framework to enrich data analysis. Specifically, on a discussion forum, themes can be discussed with important information not only risk but about any corporative issue. When the company has a corporative BI, the framework can be a good source of knowledge and this kind of tool can transform good information in corporative wisdom.

[FG04]: Important information discussed on forums it may be lost if not registered in a new or existent risk. Using an analysis tool like a BI, the information can be captured without need a mediator trigger.

Reports can be an important tool for project manager communicates risks status. A reporting tool will enable project manager and team generate risk status for specifics projects, compare results and monitor updates daily. According to participants, visual information with graphics is important communication tools for status report meeting with executives.

[FG07]: Visual reports are important, how can we generate those reports?

[FG04]: A reporting tool can access the data to generate the graphics. For me, it´s very important to generate visual information with graphics for status report meeting. The directors like to see graphics with red color in urgent information.

When a company has a corporative knowledge base, the data stored on the framework should be replicated for this repository. This repository can store information about another PM process, can store information about the product developed by a project or any kind of corporative information that can be supplemented by risks information.

[FG06]: An external knowledge base can access this framework to store information about the risks and the methodology. Any knowledge base user can access this information to

know what works or not in the specific project, or a team implementing new process can learn how a methodology is working in the company.

[FG01]: For a corporative knowledge base, information about project risks can be very important. The company can discover trends that can be avoided for risks and stimulated for opportunities.

4.2. ANALYZIS OF INTERVIEWS

The interview protocol was created for gathering experience in implementing and managing risk management process of twelve experts. The respondents were stimulated during the interviews to talk about their experience, about what has contributed or not to a successful risk management process implementation and project risk management activities according to their opinion.

In the beginning of all interviews, the respondents talked about their experience as project manager, their theoretical training and certifications. Although all respondents have presented a huge theoretical basis, they were stimulated to talk about their practice, even when this practice could conflict with theory or conflict with PM standards. The researcher has tried to make clear to all respondents that the interview was not related to any kind of test or an evaluation of the respondent's capacity. The goal of the interviews is to understand risk management in real life, gathering point of view from project managers and their experience in projects.

After explaining to respondent the objective for the interview and get information about respondent´s profile, the interview was structured in four sections with a specific and complimentary goal for each section. The first section of questions aimed to gather information about the experience implementing and executing risk management process. The second section is focused in understanding how works the collaboration and communication among the respondents and project team, sponsors and stakeholders. The third section gathered opinions about how a risk management tool could help respondents to improve results for risk management process. The last section was about framework beta version, presented in Figure 20, aiming gather opinion about what are the positive and negative aspects, what could be changed and identify some critical success factors for implement this

framework. Appendix B shows the questions applied in all interviews, according to some answers additional questions were applied to gather more and detailed information about the theme discussed.

4.2.1. Risk Management experience

This section on interviews aimed to propose a deep discussion about risk management in real life, proposing a discussion about what worked or not for respondents when they were managing their projects. The questions covered the implementation of risk management process, managing risks on projects and respondents' opinion about what can contribute to successful risk management results.

Risk Management process implementation

Five of the respondents have experience implementing risk management process. Three of them has participated in the implementation collaborating to the implementation in a role like a council, giving an opinion about what should work or not and feedbacks about the application of the process in projects. Two of them have experience as the project manager in charge of risk management process implementation.

All respondents did the implementations of risk management process as part of the PM process implementation. For some respondents, implement PM process according to company needs including risk management on that can facilitate acceptance from the entire company. The implementation of risk management process as standalone can generate distrust with the team and create barriers to a successful implementation.

[E06]: Implementing risk management process detached of a project management process implementation can generate discussions about how to avoid risk management. In discussions like that, the people involved try to find justification for not implement and start to list reasons for some project be an exception that not needs or not have time enough to risk management.

Analyzing the transcription of the answers about risk management process, some of the recurring words cited by respondents were related to culture, barrier, resistance and project manager. All the respondents with experience on risk management process

implementation have cited these words in different contexts, but in all of the contexts, this words were cited with relevance to the process. For a successful implementation, according to respondents, PMO or any other department in charge of the implementation cannot neglect these aspects.

Respondents identified different types of barriers, all of them has described that found an initial support inside their companies when started process implementation, but discussions, particularly about risk management in specifics projects, has suffered resistance. One of the respondents said that his team was very uncomfortable to create a list of risk in the project and communicate to CIO (Chief Information Office).

[E09]: After get approval for the process, we elected one project run as a pilot (...). To discuss risk I sent an invite for a meeting with all the team. When we started a brainstorm to identify potential risks, one of the participants said that was uncomfortable to write a specific risk and report to CIO, after this observation part of the team has agreed with him and asked to not add that risk.

For another respondent, develop the process and gain approval it is not a challenge because in theory everyone agrees with risk management process and accepts that this process can support a project to reach the objectives. When this process is implemented and applied in projects some problems appears, when the team does not have a clear understanding of the process and policies the team can be unconfident to participate or, relate this activity as an exclusive project manager activity.

[E05]: Although we had formal acceptance for the risk management process and communicated about this process to the team. They were not contributing with project managers.

[Researcher]: How was the communication.

[E05]: PMO sent an email for everyone in IT department communicating the new project management process. The communication has included the information that the processes as mandatory for new projects. But about risk management, only part of the team has collaborated after a huge effort from project management team asking collaboration. Part of the team was not confident in write corporative risks generated by managers or directors, like lack of definition from management.

Corporative culture were an important aspect cited by respondents, to implement and execute risk management is necessary to identify how the company deal with risks, for this identification, is important to analyze how the word risk can impact collaborators. Four of the participants has identified their companies as not familiar with risk discussion, although risk is intrinsic in business it is not discussed. One of the participants has related that was the instructor for in-company training about risk, in a topic about risk response he told that a risk could be accepted and gave some examples for that. One manager that in training did not accept any argument, in his opinion a risk never could be accepted, any other strategy should be done.

[E09]: When I started to talk about risk response strategy, I presented a slide with the strategies (...). About accept the risk, I tried to give some examples and I said that when the sponsor does not accept discuss identified risks he is accepting the risk. One manager in the training did not accept my arguments, in his opinion when a project has the budget approved with cash flow being respected the team is in charge to avoid risks, after approved a project new risks be presented requesting more money, that means a project with no limits and any problem I will request more money.

One aspect of the corporative culture that can impact risk management is confidence in company history. For some collaborators, if the company has a history of many years of success, changes like a risk management process means the fear of management team about the future, or external fad being implemented by new managers.

[E05]: In a risk management meeting coordinator sad that, all this discussion about risk was just to project managers. He is working in the company more than 15 years, and now he is feeling this change in managerial behavior, they are not confident in their decisions.

[E09]: A collaborator said that respect standard guides and best practices, but company history could not be ignored. He could not imagine the president or some of the directors discussing risks with project managers or any other person. They have their own way to manage the company and for them, these processes are just fad brought by new managers.

Project managers have a very important role to successful risk management process implementation and managing risks in the project, but is challenge find a way to balance this role. The project manager can lead the team through this process, but he cannot be alone on that. Project team should be in charge of the risks being supported by project manager and functional manager.

[E01]: For everyone in my company, the project manager has to monitor the risk and communicate if occurs. Sometimes when an event occurs, nobody notifies that waiting for a project manager.

[E12]: Risk management is a project manager centric process, we need to command all the time. It´s very difficult to be efficient if you are alone managing risks.

Critical Success Factors

The researcher asked opinion from respondents about what is important to a successful risk management process. Some of the facts related to previous questions were repeated, like cultural aspects and well-defined project manager role. New factors were described by respondents like, training for the project team, an adequate tool to support the process, collaboration of the project team and implementation of PM methodology. Those factors were cited by a significant part of the respondents and, because of this, were coded by the researcher as an important group of critical success factors. Others factor were cited by respondent but were not find in others interviews, this factors were coded as individual critical success factor but cannot be extrapolated as important to the group of respondents. Some factor cited were creation of PMO, project manager hiring, the creation of risk management community and the creation of risk management fund to be used by all corporative project.

Corporative risk management training is one of the most important critical success factors for respondents. In their opinion, many collaborators have not a clear understanding of what is a risk. Without a clear concept of risk, those collaborators are not prepared to collaborate with a risk management process. It is necessary corporative training starting from the basics concepts about, what is a risk, what is an event that may cause the risk, techniques to identify risks and risk response strategies.

[E10]: In my company, we are identifying risks for all projects in IT department. But, many time I am facing some problems about identified risks with my manager. The last

project that I created a list, my manager asked to add the risk of a specific coordinator delay an activity. I said to him that, delay an activity is an impact but I need to identify the cause to act on that. My manager said that it is not a project manager role manage coordinators problems, what I need to do is add this risk and show to her manager. For me, it was clear that my manager does not know some basic concepts of risk management, but it is difficult to me say that to my boss.

[E03]: It is important training about risk management. I was the instructor for this training, and as part of the training, I ask participants to list risk of an actual project they are working. With this list, we can create a class discussion about how to evaluate the risk and together we can have conclusions if it is important or not monitor the risk.

After a training for basic concepts of risks, it is possible to start the training for risk management process. Leveraging risk concepts, training about the corporative processes can gain a better participation and quality. Training participants with a clear concept of what is risk are prepared to discuss the process, sometimes can suggest improvements and in the end of the training, those participants can start to practice risk management in their projects.

[E03]: Training about risk management process should have a basic concept as the first lesson. After that, the collaboration and interaction of the students in classes change. Discussing the process, sometimes we can find a rich contribution to the process.

[E04]: After training, some people are excited to contribute with project manager to manage risks. We need to find a way to keep this energy up after six months or one year.

The implementation of a risk management methodology is an important factor to support risk management. Six of the respondents has cited this factor as important to successful results managing risks. The adoption of a methodology by the company can create an adequate environment for projects and all activities of risk management will gain support with that.

Adopting a PM methodology will make easier demonstrate the importance of risk management. It is possible to show how this process will contribute to project, for example, adding risk clauses in contracts created by procurement process. Another example is about

time management, risk management can contributing identifying probabilities of accomplishing activities on time.

[E11]: We should not think of risk management implementation as an isolated process implementation. Risk management as part of a bigger process makes more sense and contributes to show results as risk scheduling, costs, contracts and with human resource.

[E05]: My experience was implementing project management process, not an isolated process. Risk management is a process that sometimes can expose collaborators, so you need to do that executing project management. Risk management is one of the results in risk management process.

[E09]: A successful project management process, improves the chances of risk management.

Two critical success factors cited by respondents were project team collaboration and risk management tool. Both factors are explored in next sections of the interview and details about respondents' opinions are described on correspondent section analysis.

4.2.2. Collaboration on Risk Management

To improve the support of the framework proposed in this research to stimulate collaboration from project team with risk management process. This section of the interview aims to understand how is the collaboration among all collaborators in respondent´s companies and what need to be improved on this process.

Except by the project manager and PMO, all others member and departments are a passive agent on risk management process. That means, project managers are in charge of all activities, the others collaborate when asked by the project manager and there are collaborators that no accept to collaborate with risks. Because of this scenario, risk management is restricted by project manager bias, if he/she feels that the project is a low risk the process of risk management can be neglected.

[E08]: I do all risk management activities for my projects. I need to gather information with everyone and keep it up to date alongside project life cycle.

[E07]: If the project manager does not ask updates, report and communication to everyone, the list of risk created on project planning will never change. The project is closed out with all risk in running status.

After process implementation, training or meetings to establish and communicate the importance of risk management, the participation of team members increase but, after some time this participation diminish. Keep a risk management collaboration spirit in team members is a huge challenge, respondents has described different examples about how difficult is that for different reasons and, in their opinion, sometimes with team member excuses to not participate.

[E03]: I saw many times in the of risk management training, the participants talking about risks, planning risk for their projects. But, after some month risk management is ignored.

Even project sponsors do not collaborate with risk management process. For some sponsors risk management should be managed by project managers, for others, functional managers should help project managers and avoid any risk. For sponsors, their role is to approve funds to project and receive status from the project team. They does not feel themselves as part of the team with any activity on that.

[E08]: All projects in my company should have a director as sponsor. After a director approves a project, what he wants is just receive reports about project status. If something is going wrong the responsible needs to show a recovery plan. It is impossible a director collaborate with an activity, a director will not give inputs about risk or discuss risk status.

When implementing and running risk management process, companies should plan how to keep team collaborating and executing risk management on projects. The interviews respondents did not present a common view in how to keep this collaboration, they mentioned some ideas in how to do, but all the respondents is facing this problem with not success results.

[E05]: The CIO and directors should support project manager. If team member feels that the bosses if with their eyes on that, everyone will monitor the risk and keep the information up to date.

[E07]: If a person sees that there is no difference for his personal evaluation or compensation when he is collaborating or not with risks, he will do what is easier to him. I mean, he will ignore risks and will have this time free.

[E02]: Keep team collaborating means keep company collaborating. Everyone should be working on that, the steering committee should discuss risk for all project and give support to project management and encourage project team.

4.2.3. Risk Management Tools

The adoption an adequate tool to risk management is one important part of the process according to respondents opinions. A tool will help project to gather information needed, communicate with the project team and with stakeholders. An efficient tool will keep risk registers available to everyone that needs this information and will be used as knowledge base for future projects.

[E12]: Risk management requires a tool, it is not possible to do use Excel spreadsheets of Word tables. Tools like that can help the project manager to keep reminders for himself but you can´t demand a team member keep a risk status up to date in a spreadsheet being accessed by everyone. You need to have a control about who is changing what and when.

[E01]: The tool helps to ask asynchronous inputs from the team, I don´t need to create a meeting with everyone, I give a due date with the team finish their input and they do when having agenda.

[E07]: If you have a tool with documented risks, project managers in new projects can access and find risks for similar projects.

Respondents were asked about what are the main functions for a risk management tool, what in their opinion are the requisites for this tool. Answering this question, respondents has listed features like, web access, individual logins, control of profile to define what each user can do in the tool and creation reports. The list of requisites create based upon respondents answers is focused on features to facilitate team access, control what is changed

and help to communicate with stakeholders. The main features listed are: web access; mobile access; login control; update logs; semantic search; visual reports; integration with emails.

Although the respondents agree that a tool is important to the process, many of the when asked to answer have emphasized the importance of the team collaboration. A tool will help project manager managing risk, but inputs from a team member and their collaboration are the factor that becomes the process successful or not. A company should bear in mind that just the fact of acquiring a risk management tool will be enough to run the process, the focus should be on people and the tool will support them.

[E02]: The tool it is important, without a tool you can´t manage risks. But people are fundamental if they not collaborate or give wrong inputs, nothing that project manager do will fix this problem.

[E11]: We can´t focus only on the tool, we need to focus on entire process and emphasize the need for teamwork.

[E09]: There are managers that think if acquire a tool that is running success in another company the result will be the same in his company. It is not just acquiring a tool, people should be prepared and motivated to participate.

4.2.4. Analysis of preliminary framework: Beta Version

In this section of the interview, respondents were asked to give their opinion about how this tool can help risk management process, what are the strengths and weaknesses and asked suggestions to change the framework. The beta version of the framework, Figure 20, was presented to them as framework created by another author and the objective of the researcher was to adopt an adjusted version of the framework based upon interviews.

After showing the framework and explain in details each part of the figure, the researcher asked their opinion about the adoption of a risk management tool and if this adoption is feasible. The adoption of the framework to support 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 inputs and consuming risk information.

[E02]: This tool using wiki pages can stimulate the collaboration. Adopting this tool the company can inherit the spirit of participation existent on the internet like in Wikipedia.

[E12]: This tool will permit team members to access the list of risk is his responsibility and update it. After this updated anyone in the company, including his boss will see his collaboration. With this tool will be clear who is collaborating or not.

[E11]: This tool can show to everyone, the project manager is not the unique in the project in charge of monitoring the risks. This view may be an important step to disseminate the culture of collaboration and can be adopted by other project management area.

An aspect cited by respondents is the integration with others PM tools. Due to the framework be based upon wiki pages that do not any kind of quantitative analysis, this tool should be integrated to store risk quantitative analysis and link with correspondent risks. Schedule tool should be integrated with risk management, if the company adopt a web-based schedule tool, the risks related to any scheduled activity should be linked and accessed from the framework.

[E01]: My Company uses Crystal Ball for risk simulation. This framework could be an integration to store the spreadsheets results.

[E06]: Many of the risks are related to a specific activity on MS Project. I would add an integration with MS Project to create hyperlinks for this relation.

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

[E03]: You need to integrate this framework with portfolio tool to permit relation of risks among projects. Corporative risks can affect many projects, give this information to CIO is very important.

[E03]: When you have a risk that affects more than one project, the project managers should duplicate the information. In the past, we had the same risk reported by two project managers with different status.

The framework W4RM was created based upon the interview. Figure 21 shows the framework version 1.0, this is the final version of the artifact developed on this research.

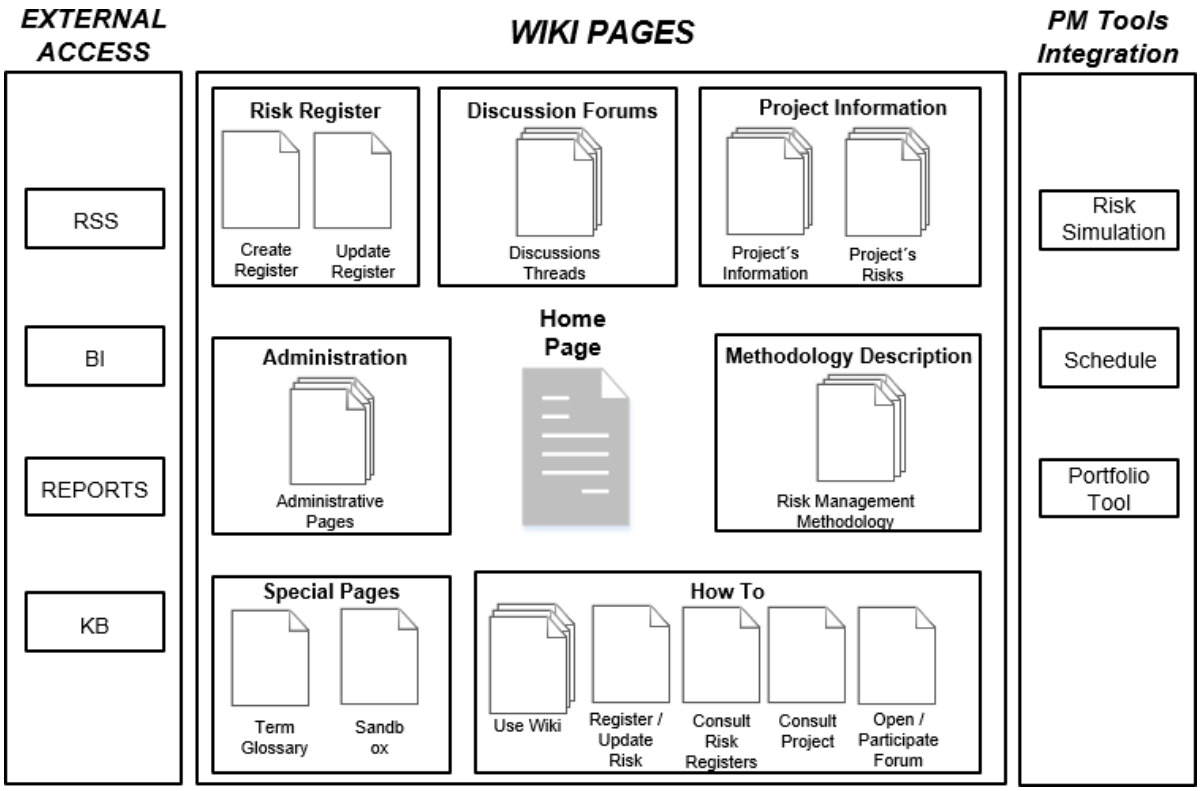

Figure 21 – W4RM - Version 1.0

Comparing the beta version in Figure 20 with the W4RM version 1.0 in Figure 21, there are no changes on ‘External Access’ and ‘Wiki Pages’ sections. In this version was added ‘PM Tool Integration’ to create a layer of integration with PM tools. This layer will permit hyperlink with tools, or use the framework as a repository for information created on external tools.

Integration with risk simulation tools will use the framework as source of information for the external tool. After obtained results on simulation tool, the framework can be used as repository and correspondents risk linked with that. This integration will permit responsible to evaluate the risks rightly and keep the information and status up to date.

Schedule tool integration will permit create a view of all risks related to a specific activity. Allowing responsible for an activity the view of risks related to his activity, related to the package of activities or with a specific Work Breakdown Structure (WBS) level. Even when a responsible for an activity did not participate in the risk identification, he/she can access the risks associated with the activities or risk not related to the specific activity but may impact his job.

Risk management can support all other risk management areas, risks associated with all areas are evaluated and monitored. Create integration with portfolio tool can enrich the contribution of risk management for the entire project and can help to monitor risks. In portfolio tool can create views using framework data, generating management information, risks related to portfolio and support to a decision.

4.3. DISCUSSIONS

When the focus group started, participants introduced themselves by giving a short description of their professional experiences, their own weakness, past failures and critics about their organizations they work at. The mediator encouraged them to talk about their experience on reporting risks to project sponsors. At this point some participants gave some examples on how project sponsors avoid getting any responsibility on risk management.

In the interviews, respondents gave more details on their activities on risk management. On the other hand, in the focus group, participants were more concise as they described the procedures they conducted in the process of risk management. During the focus group participants interacted with each other and corroborate each other's opinions.

Focus group participants were more pessimistic about project team participation in risk management. In turn, some interviewees reported that they would engage their teams on risk management by using tool and communication techniques. I also realized that interviewees were more process-driven than the participants of the focus group.

Adopting two different methods of data collection enriched the research and provided a wider perspective on risk management in IT settings. Certainly, the analysis of the content of the interviews and of the discussion on the focus groups allowed me to improve the W4RM framework.

5. CONTRIBUTIONS FOR ACADEMICS AND PRACTITIONERS

The role of scholars and educators in professional schools of management is to conduct a research that contributes to create applicable knowledge that can help practitioners (Van de Ven, 1989). According to Corley and Gioia (2011), the value of management has been defined according to two aspects, scientific usefulness and practical usefulness. This chapter presents the contributions of this research for both aspects, theoretical and practical usefulness.

5.1. THEORETICAL CONTRIBUTIONS

Theoretical papers should offer relevant and useful insights (Kilduff, 2006). In fact, scientific works should provide original insights about a phenomenon (Corley & Gioia, 2011). Corley and Gioia (2011) define two dimensions for theoretical contributions, originality and utility.

This research has contributed to academics by reviewing the literature about two constructs - IT project risk management and wikis - and by analyzing the relationship between them.

W4RM has many of the wiki characteristic and can be used to support the related RM issue. For example, W4RM can be used to gather and disseminate information from/to different levels of organization in order to support risk management. W4RM can also encourage the collaboration within team members, avoiding project manager bias. By implementing the W4RM framework managers will be able to get different perspectives of risk identification and monitoring.

The W4RM can be used to register and monitor both endogenous and internal risks (Jani, 2011). Project managers can assign these risks to any member of the team.

Considering the feedbacks and responses the interviewees and focus group participants, the W4RM can be useful to support risk management in IT projects, regardless the type of industry. This fact indicates the inferential generalization (Ritchie et al., 2013) proposed in the framework.

5.2. CONTRIBUTIONS FOR PRACTICE

By adopting a constructivist ontology, I could use social interactions with practitioners to corroborate research results. Focus groups and interviews allowed me to encourage these practitioners to share their problems and to find things in common.

W4RM serves as a means to facilitate project managers' communication with project team members and stakeholders. This framework will facilitate the access to risk policies, methodologies and risk status. Besides that, this framework will help project managers to address delicate issues as well as to avoid communication problems. Frosdick (1997) and Kutsch and Hall (2009) affirm that that project managers do not talk about risks in order to avoid conflicts with team members and stakeholders. Another important contribution is the W4RM framework can help PMO´s to spur cooperation and participation within employees.

W4RM is a tool that creates an environment for collaboration which facilitates continuous risk management. Community members can get responsible for keeping the report and monitoring of risks.

In line with Kerzner (2015), collaborative tool like wiki can help establishing a new paradigm of participation in projects, especially for RM. Wiki implementation will enable a creation of a community of risk management. This community is established and maintained by employees. This community will be able to discuss risks related to all projects of the organization.

Practitioners have corroborated some findings of previous studies on risk management. Risk management is recognized as an important critical success factor in project management. However, organizational culture is mentioned as a barrier in risk management, as some organizations are resistant to talk about negative aspects and past failures.

W4RM can be adopted with no cost to the organization, as the framework can be implementing by using any wiki tool. There are some free Wiki platforms available on the Internet are MediaWiki, DokuWiki, PmWiki, WikkaWiki, TWiki and XWiki. Some of these platforms are available online and others can be downloaded and installed in workstations.

6. FINAL REMARKS

As mentioned above, the research question I aimed to answer is: how can wikis support risk management in IT projects? To answer this question, I set three specific objectives: to verify gaps in project management literature regarding risk management; to analyze how wiki pages can improve risk management; to develop a framework to support risk management based on wikis; and to validate the proposed framework by getting feedbacks from experts.

Figure 11 presents the findings regarding the first objective. These results indicate that it is possible for project managers to adopt a collaborative tool like wiki in order to improve risk management in IT projects. The collaborative characteristics of wikis can bring positive results in the process of risk management as they address issues such as lack of team members' involvement, organizational cultural and lack of collaboration from project stakeholders.

Regarding the second specific objective, I designed the W4RM framework based a detailed review on literature about Web 2.0 tools and risk management. As I reviewed literature on this theme, I concluded that free platforms present some setbacks such as restricted number of logged users and lack of some functions such privacy and security.

About the third specific objective, I validate the framework by conducting a focus group and interviews with experts and practitioners on IT project management. The insights and feedbacks collected during these two processes helped me to realize that the framework should be integrated with PM tools and other corporative systems in order to embody all knowledge generated within the organization. By establishing the use of W4RM framework in this manner, project managers will have access to a corporative risks repository which will facilitate their work on decision-making.

Research findings also show that the importance of integrating people, processes and technology on PM. Based on that, the W4RM presents has a limitation as it only focus on the technological element on risk managements. Further studies are needed in order to address factors related to human aspects and organizational processes involved contained in the processes of risk management on IT settings. Besides, I reckon that implementing W4RM is

not enough to solve all the issues regarding risk management. To do so, organizations need to change and implement new organizational processes as well as to build an organizational cultural that spurs knowledge sharing.

For future researches, it is recommended to validate the W4RM framework empirically to identify the pros and cons of the framework. This empirical study can be conducted among professionals on PM that already use by Web 2.0-based tools.

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APPENDIX A – FOCUS GROUP PROTOCOL

ASPECT	#	QUESTION
Barriers and difficulties on risk management	1	What difficulties have you dealt with as you manage risks on IT projects?
	2	Can you list in topics the difficulties?
	3	Do you apply risk management in all projects that you manage?
	4	For those not 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 stakeholder in 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 risks are monitored and updated?
	11	According to you experience, what is the project management role in risk management
	12	In your opinion, what could be the state-of-art for a project manager role managing risks?

ASPECT	#	QUESTION
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 a web 2.0 tool can help to manage risks?
Framework	*Framework alpha version presentation*	
	15	What is your opinion about use 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?

APPENDIX B – INTERVIEW SCRIPT

ASPECT	#	QUESTION
Respondent Profile	1	How old are you? For how long have been working as a project manager?
	2	What is the business sector of the organization you work at? Do you work as an employee of the organization, contractor or partner?
	3	Do you have experience on working with project management methodologies?
Risk Management Experience	4	Can you describe your experience on managing risks on projects?
	5	Have you implemented any process on risk management? If you have, how was this experience?
	6	In your opinion, risk management is important for project success? Why?
Collaboration on Risk Management	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 you omit some? Is there some type of risks you cannot inform to the ones involved in the project?

ASPECT	#	QUESTION
Risk Management tools	10	In your opinion, how a Web-based tool or application can help project managers on their work on 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 risks IT projects?
Framework	13	Do you have any experience in using wikis on professional settings? Or have you ever participated on 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 advices would you give for a future implementation of W4RM framework in organizations?