Risk Management in Information Systems Projects

Luca Álvares Guedes Vaz
luca.vaz@ist.utl.pt

Instituto Superior Técnico, Lisboa, Portugal

May 2016

***Abstract*— All Information Systems Projects involve risk of some sorts and these projects are becoming increasingly complex, intensifying therefore the probability of various risks. Risks cannot be avoided but they can be managed in ways that they are recognized and their impacts accepted, avoided, mitigated or transferred. Frameworks like, PMBOK and PRINCE2 provide guidance and principles that contribute to achieving success in Risk Management processes in Project Management.**

The Risk register, sometimes referred to as risk log, is a key part of documenting any risk analysis effort and one of the most important supporting tools of risk management, enabling storage and communication of information in a relevant, consistent and concise manner. This could take various forms such as a spreadsheet or database and will act as a central repository for the information gained on each risk.

The purpose of this dissertation is to propose a reference risk register, based specific a domain model, following a methodology which will allow the creation of a Reference Risk Register.

***Keywords*—Risk Management, Risk Register and Project Management**

1. INTRODUCTION

All projects have risks. These risks come from the nature of the work, from the resources, the contractual relationships or the political factors.

The subject of risk management has become increasingly important for different organizations. This is the result of the increasing use of projects in association with project management techniques, which are needed for achieving desired changes in the organizations.

Considering that cooperation amongst organizations is fundamental, compliance with international standards is important for better acceptance of process activities and objectives.

Risk Register, sometimes referred to as risk log, is a key part of documenting any risk analysis effort and one of the most important supporting tools of risk management, enabling storage and communication of information. But all the risk Registers found were not consistent, thus making it difficult to structure, being that there is such diversity to the structure, this makes it quite difficult and complicated for one to reuse and compare them.

Although there are several Risk Registers, they lead to a problem where they may have common objectives and purposes, but are structured in different ways.

This big diversity of Risk Registers is the problem addressed by this work, resulting in a proposal for a generic Reference Risk Register.

2. RELATED WORK

2.1 ISO Standards

The International Standard, ISO 31000:2009, entitled Risk Management – Principles and Guidelines [1] , will ensure that the information about risk derived from these processes is adequately reported and used as a basis for decision-making at all relevant organizational levels. This framework is intended to assist the organization to integrate risk management into its management system. The risk management process should be an integral part of management, embedded in the culture and practices, and adapted to the business processes and context of the organization.

The processes for Risk management implementation is presented in Figure 1.

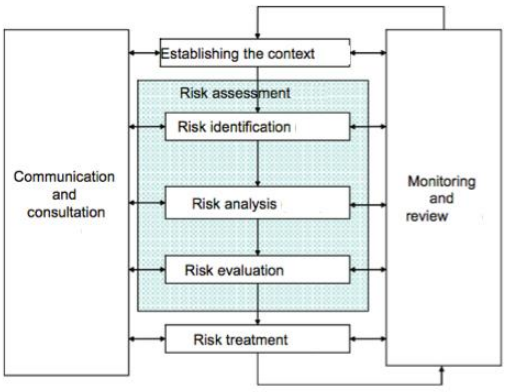

Figure 1.ISO31000 Risk Management Processes. Extracted from [7]

The ISO 31000 is important for this dissertation because it focuses on frameworks for risk management and processes to implement it. These frameworks are an important and complex area of project management and will constitute the basis for developing the narrative of this dissertation. There is also the ISO Guide 73:2009 [3] that provides the definitions of generic terms related to risk management. It provides a coherent

approach to the description of activities relating to the management of risk, and the use of risk management terminology in processes and frameworks dealing with the management of risk.
The ISO 21500 is an international standard, which is intended to provide guidance, explain core principles and what constitutes good practice in project management.
ISO 21500:2012, Guidance on Project Management, as quoted in [6] :"*ISO 21500 provides generic guidance on the concepts and processes of project management that are important for the successful realization of projects.*" This ISO can be used by any type of organization, including public, any organizations and for any type of project, regardless of complexity, size and duration. It can be aligned with other standards, such as, ISO 31000:2009, Risk Management.

2.2 Relevant Frameworks

The Guide to the Project Management Body of Knowledge (PMBOK) provides guidance in individual projects management and the concepts related to it [5] . Furthermore it is very relevant in providing and promoting a common vocabulary within the project management as this facilitates communication within the profession when using and applying project management concepts. The PMBOK adopts a modern education model for project management. It is organized as a body of knowledge, containing nine knowledge areas. One of the areas is Project Risk Management.

PRINCE2 has some guidance on the management of risk in projects. It makes a distinction between business risk and project risk. Business risk, which is the responsibility of the project board, relates to things that might damage the business case. Project risks are those things, which could prevent the achievement of the project objectives. PRINCE2 recommends that an assessment of risk should be made at the inception of a project and that risks should thereafter be reviewed at significant points in the lifecycle of the project, such as the transition between stages. This framework is a scalable, flexible project management method, suitable for use on any type and any size of project.

In PRINCE2 the purpose of risk management is to identify, assess and control uncertainty and, as a result, to improve the ability of the project to succeed [9].

Basically the PMBOK and PRINCE2 are frameworks with different processes, both somehow using the same definitions and methods in Risk Management. This also happens for other frameworks, some names are different but their purposes are the same.

3 Problem Analysis

3.1 Risk Management in Project Management

In this dissertation, Risk Management is considered a Project Management process.

Effective risk management strategies allow the identification of a project's strengths, weaknesses, opportunities and threats. To ensure the project's success, we must define how we will handle potential risks so we can identify, mitigate or avoid problems when needed.

The benefits of risk management in projects are huge. The result will be the minimization of the impact of project threats and seizing of the opportunities that might occur. There are some important steps to perform when using the risk management processes in projects. First always have a risk management strategy or a plan risk management, then identify risks early, communicate the risks, clarify ownership issues, prioritize risks, analyze risks, plan and implement risk responses, maintain a risk register and finally monitor the risks.

There are some standards and some useful frameworks such as PMBOK and PRINCE2, as explained in section 2.1.2, that are very similar in how they act in helping us to have a good risk management strategy.

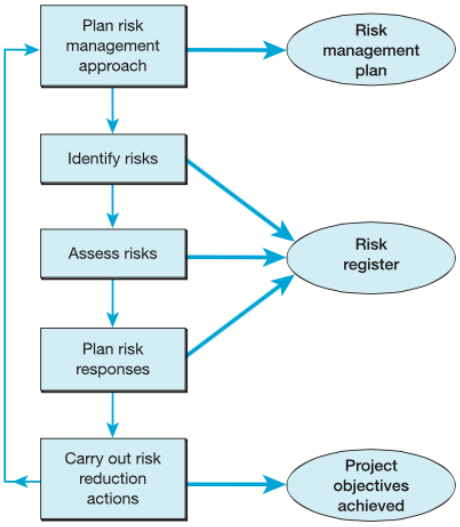

Figure 2. The Risk Management Process. Extracted from [7]

In Figure 2 is presented the generic risk management process.

3.2 The relevance of a Risk Register

Risk register (sometimes referred to as risk log) is a key part of documenting any risk assessment effort (including the identification, analysis and the evaluation) and one of the most important supporting tools of risk management, enabling storage and communication of information in a relevant, consistent and concise manner. This could take various forms like a spreadsheet or database and will act as a central repository for the information gained on each risk. Most of the risk registers found were not consistent, it is also important to recognize that there is a great diversity of these risk registers,

which makes it very difficult to reuse and to compare between them.

In Table 1 are pointed the activities referred in ISO21500, PMBOK and PRINCE2, where the concept of risk register is referred to as an input or an output.

ISO21500 risk processes	**INPUT**	**OUTPUT**
Identify Risk	Project Plans	Risk Register
Assess Risk	Risk Register	Prioritized Risks
Treat Risk	Risk Register	Risk responses
Control Risk	Risk Register, Risk responses	Corrective actions
PMBOK risk processes	**INPUT**	**OUTPUT**
Identify Risk	Risk Management Plan, Project documents	Risk Register
Perform Qualitative Risk Analysis	Risk Register	Project documents updates
Perform Quantitative Risk Analysis	Risk Register	Project documents updates
Plan Risk Responses	Risk Register	Project documents updates
Monitor and Control Risk	Risk Register	Change requests, Project documents updates
PRINCE2 risk processes	**INPUT**	**OUTPUT**
Identify Risk	Risk Management Strategy	Risk Register
Assess Risk	Risk Register	Risks evaluated
Plan	Risk Register	Risk responses
Implement	Risk Register	Corrective actions
Communicate	Risk Register	Communicate the status of the risks

Table 1. Inputs and Outputs of the risk processes from ISO21500, PMBOK and PRINCE2.

3.3 Risk Breakdown Structure

The risk management process aims to identify and assess risks in order to enable the risks to be understood clearly and managed effectively.

There are many techniques for risk identification. These identification techniques tend to produce an unstructured list of risks that often do not assist the project manager in knowing where to focus risk management attention.

The most obvious demonstration in the value of structuring within project management is the Work Breakdown Structure (WBS), which is recognized as a major tool for the project manager because it provides a means to structure the work to be done and accomplish project objectives. The aim of the WBS is to present project work in hierarchical, manageable and definable packages to provide a basis for project planning, communication, reporting, and accountability.

Besides the WBS there are also:

- **OBS** (Organization Breakdown Structure). Categorizing risks using the OBS shows where risks lie in relation to the areas of responsibility of the various individuals, teams or groups in the project organization, and can be used to propose appropriate risk owners for risks.
- **CBS** (Cost Breakdown Structure). Linking risks into the CBS allows the cost of risk impacts and planned risk responses to be mapped into the project budget, exposing which cost elements are most uncertain, allowing calculation of an appropriate risk budget, and suggesting where contingency might be required.
- **RBS** (Risk Breakdown Structure). Grouping risks by the RBS indicates common sources of risk, allowing preventative measures to be taken, and increasing the efficiency of risk responses by targeting root causes to tackle multiple related risks.
- **RiBS** (Risk impact Breakdown Structure). Mapping risks against the RiBS allows analysis of the types of risk exposure faced by the project, indicating where the management team should focus attention when developing risk responses.

A better solution to the structuring problem for risk management would be to adopt the full hierarchical approach used in the WBS. Such a hierarchical structure of risk sources should be known as a Risk Breakdown Structure (RBS).

The RBS indicates the source from which the risk has arisen. Another key characteristic of a risk is its consequence or impact and for that impact characteristic there is the hierarchy called the Risk Impact Breakdown Structure (RiBS).

4 PROCESS DEFINITION

This process definition follows the principles, guidelines, techniques and concepts provided by the ISO 31000 family standards [1] [2] . To provide background on the terms used, some of the terms are presented below, accordingly to the ISO-Guide73 Risk Management – Vocabulary [3]:

Assets - anything that has value for an organization or for a project.

Events - the occurrence or change of a particular set of circumstances.

Consequences - the outcome of an event, which affects objectives.

Risk - effect of uncertainty on objectives. An effect can be positive or negative.

4.1 Methodology

In Figure 3 is presented the proposed methodology for the creation of the Reference Risk Register.

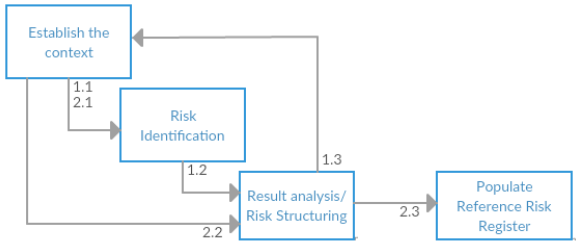

Figure 3. Proposed methodology for the creation of the Risk Register

This methodology is based on two iterations, each iteration with 3 steps (the establishing of the context, the identification of the risks and then the analysis of the respective risks).

First iteration

1.1. Establish the context

The output of this iteration will be the definition of the assets and the definition of the scope.

Everything that, in advance, does not permit the start of a project, is out of the scope of the project, and the only concerns are the risks that have consequences on my assets between the start date and end date of the project, everything else is out of the scope.

1.2. Risk identification

Exhaustive analysis of risks and the population of the risks in an excel sheet.

Once is established the context and identified the assets (Deliverables, Money and People), comes the phase of the identification of the risks and populate them in an excel sheet. The output of this step will be a list with all risks identified.

1.3. Analysis of the identified risks

Risk analysis and removal of the risks that are not within the scope. In this step is described the analysis of the list of risks resulted from step 1.2. Some of the risks identified in step 1.2 were not within the scope of the project and the consequences were not over the assets defined in 4.4. After identified the risks that are within the scope, comes the organization and structuring of the risk register with different columns, the identifiers of the Events and Consequences along with an annotation of the risk.

Second Iteration

2.1 Establish the context

Use the same context as the 1.1, but now the output of this iteration, along the output of the step 1.1, will be the structuration of the list of risks obtained in step 1.3 using the Risk Breakdown Structure.

2.2 Risk Structuring

Now that we have a clear list of risks resulted from step 1.3, this list is not structured, but a simple list of risk sources does not provide the richness of the WBS since it only presents a single level of organization. A solution to the structuring problem for risk management would be to adopt the full hierarchical approach used in the WBS. Such a hierarchical structure of risk sources should be known as a Risk Breakdown Structure (RBS). The RBS (Risk Breakdown Structure) will allow grouping risks and indicating sources of risks, the same with the RiBS (Risk impact Breakdown Structure) but this one will group by impact. And that will be the result of this step, a structure that will allow an overview of the risks for a better identification.

2.3 Populate the Reference Risk Register

This is the last step of the proposed methodology that consists in populating the reference risk register, but now with all the information we need, with the list of risks from within the scope of the project the identifiers of the consequences, events and also with the small annotation where the risks can be found, the RBS levels (Level 1 and Level 2) from which the risk is mapped. In Figure 9 the reference risk register can be found, along with the RiBS levels (Level 1 and Level 2) from which the risk is mapped, these last two structures are the result from step 2.2 of this methodology.

4.2 Domain Model

In Figure 4, is presented the proposed domain model for this dissertation.

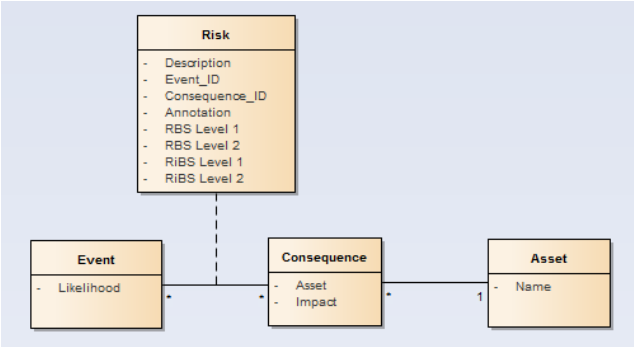

Figure 4. Domain Model

The entities that compose this domain model are:

Risk, that has a description of the risk; an Event_ID is the id number of the Event; Consequence_ID is the id number of the Consequence; Annotation is a column with a location of the risk; RBS Level 1 is the first level of the Risk Breakdown Structure, so it can be filtered for an easy identification of the risks; RBS Level 2 is the second level of the Risk Breakdown Structure, so it can be filtered for an easy identification of the risks; RiBS Level 1 is the first level of the Risk impact Breakdown Structure, so it can be filtered for an easy identification of the risks; RiBS Level 2 is the second level of

the Risk impact Breakdown Structure, so it can be filtered for an easy identification of the risks.

Event, that has an ID, so that can be easily identified when looking at the Risk; A description of the Event; Likelihood or probability of the Event.

Consequence, that has an ID, so that can be easily identified when looking at the Risk; A description of the Consequence; Impact of the Consequence; and a column with the name of the asset that the consequence has impact on.

Asset, with the name of the asset.

Multiple events and multiple consequences can generate multiple risks as shown in Figure 4. The consequence is over one Asset, but one asset can have multiple consequences.

4.3 Establishing the Context

This chapter is the first step (1.1) "Establish the context" of the first iteration on the proposed methodology.

The definition of project scope makes clear what the project will contribute to the strategic goals of the organization.

In this dissertation the focus will be the Risk Identification process of the Risk Assessment process of ISO 31000 as shown in Figure 5 and in the project management processes that has deliverables as presented in the green box in Figure 6, these are the processes where Risk Management have the Risk Identification process, everything that is out of the green box, like benefits, organizational strategy, business and other concepts are ignored.

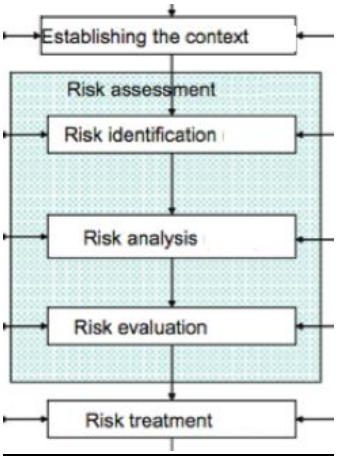

Figure 5. ISO 31000 Risk Management Process. Extracted from [7]

Everything that, in advance, does not allow the start of a project, is out of the scope of the project, the only concern is all the risks that have consequences on my assets between the start date and end date of the project, everything else is out of the scope.

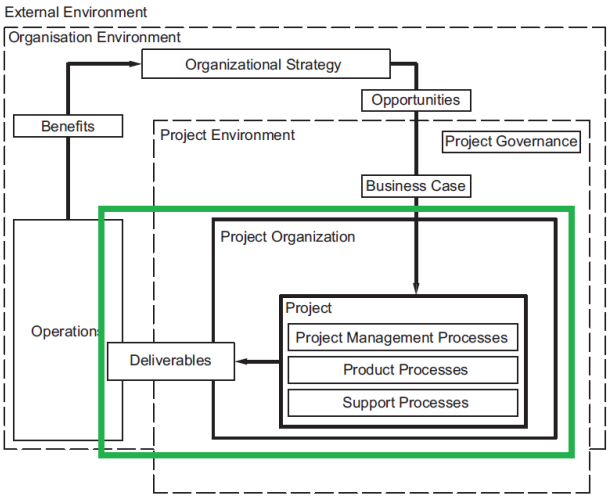

Figure 6. Overview of project management concepts and their relationships. Extracted from [17]

4.4 Assets

As quoted in [18] Terms and Definitions a project risk is a "risk relating to **delivery** of a product, service or change, usually within the constraints of **time**, **cost** and **quality**."

As said in section 4.3, a project has activities with a start and an end date, performed to achieve project objectives.

Achievement of the project objectives requires the delivery of deliverables conforming to specific requirements.[17] It is now clear that the definition of the risk management context of a project is to focus on the threats that impact assets.

As shown in Figure 6, inside the green box, these processes have an impact on any organization. These processes have also impact in the **deliverables** and clearly a project is evaluated by the deliverables that are produced. This is why the deliverables will be considered as an asset in this methodology.

Another asset that will be considered is the staff (**people**) that participate in the project because people are the core of IT Projects and everything that has an impact on them will be relevant.

The ultimate goal of any organization is to make **money**, every organization needs it and uses it to produce anything and for that reason money will be considered an asset for this methodology. With this said, the assets will be **Deliverables**, **Money** and **People**.

4.5 Risk Register

Risk register (sometimes referred to as risk log) is a key part of documenting any risk analysis effort and one of the most important supporting tools of risk management, enabling storage and communication of information in a relevant, consistent and concise manner. This could take various forms like a spreadsheet or database and will act as a central repository for the information gained on each risk.

In this dissertation the reference risk register will take the form of an excel spreadsheet with the structure presented in Table 2.

ID	Description	ID_Event	ID_Consequence	Annotation	RBS Level 1	RBS Level 2	RIBS Level 1	RIBS Level 2
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Table 2. The reference Risk Register.

The proposed structure of the reference Risk Register has nine columns, in those columns I propose there should be an ID, it is important to have a description of the risk identified in another column.

There is an event table that should have its ID related to its table.

ID consequence is related to the consequence table and occupies another column. To find a page, paragraph, link of a site, it is imperative to have a column with a location risk.

Level 1, known as RBS, is the first level of the Breakdown Structure, it filters easily identifying the sources of the risks.

Level 2, known as RBS, is the second level of the Breakdown Structure, it filters precisely identifying the risks in level 1.

RiBS Level 1 is the first level of the Risk impact Breakdown Structure, it filters for an easy identification of the impact of the risks;

RiBS Level 2 is the second level of the Risk impact Breakdown Structure, it detects the impact of the risks already seen in level 1.

The structure of this Reference Risk Register will be further populated with the risks identified, as presented in the proposed methodology mentioned in section 4.1, it will be populated in the second iteration step 2.3 "Populate Reference Risk Register".

5 PROCESS APPLICATION

The first objective of the application of the process was to apply it to a set of bibliography found on the Internet, but unfortunately, the bibliography that was found was quite disperse and inaccurate, as said in section 1.1, most of the Risk Registers and bibliography found was not consistent, there were several examples of risks without any context established, the only thing that was credible was the Project Management for Information Systems[7] where the process with two iterations was applied.

5.1 Process First Iteration

Step 1.1 - **"Establishing the context"** of the proposed methodology:

The output of this iteration will be the definition of the assets and the definition of the scope. As said in section 4.4 the assets considered in this methodology are:

Deliverables - Time (A project is always temporary, if a deliverable is delivered on schedule or not, is very important and if it is not delivered on time there will be costs added to the project); Quality (Ensuring if the quality of a deliverable meets a certain level of measure of quality is extremely important from the standpoint of achieving the project's success, also if certain quality criterias are not met it can be cost added to the project).

Money (As seen in the previous asset, if time or quality are not assured it will affect the cost of the project, but that is not all, during the project money will be very important).

People (Organizations work essentially with people, projects are made by people).

Step 1.2 - **"Risk Identification"** of the proposed methodology:

Exhaustive analysis of risks and the population of the risks in an excel sheet. Once established the context and identified the assets comes the search and identification of the risks.

After all the risks are identified, these risks are documented in an excel sheet draft, where in step 1.3 the risks will be analysed. The result of step 1.2 is a list with all identified risks, but in this list is presented some risks that are not in the scope of the project and that are not over the assets defined in section 4.4. The next step will be the analysis of the risks identified because it is clear that some risks are not within the scope of the project and some are ambiguous risks.

Step 1.3 – **"Result Analysis"** of the proposed methodology:

Risk analysis and removal of the risks that are not within the scope.

In this step is described the analysis of the list of risks resulted from step 1.2.

The risks that do not have the consequence over the assets will be moved to the excel sheet "Out of context". The risks considered ambiguous will be moved to another sheet called "Ambiguous risks".

An out of context risk means that the risk is not in the scope of the project, every risk that occurs before the start of a project or that the consequence of the risk is not over the assets deliverable, money and people is out of scope and if the risks are ambiguous means that it is a risk that has several possible meanings or interpretations and is difficult to comprehend and classify.

After removing all risks that are not within the scope or that the consequences are not over the assets defined, it is time to organize the register, clarifying the events and the consequences of the risks, creating an excel sheet with the consequences, another for the events and the main one with the risks and the respective events and consequences identifiers.

Having a list of risks sorted and analyzed, this list is not

structured so the next step would be to re-analyse the context and add to it, an appropriate structure.

5.2 Process Second Iteration

Step 2.1 - **"Establishing the context" of the methodology:**

The output of this iteration will be the definition of the assets and the definition of the scope, the same as step 1.1, but now adding to the existing context, a breakdown structure, using the RBS that is a source-oriented grouping of project risks that organizes and defines the total risk exposure of the project. Each descending level represents an increasingly detailed definition of sources and risk to the project for a better identification and analysis of the risks.

Step 2.2 - **"Risk Structuring":**

The most obvious demonstration of the value of structuring within project management is the Work Breakdown Structure (WBS), now that we have a clear list of risks, this list is not structured, but a simple list of risk sources does not provide the richness of the WBS since it only presents a single level of organization.

The WBS that is recognized as a major tool for the project manager because it provides a means to structure the work to be done to accomplish project objectives. The aim of the WBS is to present project work in hierarchical, manageable and definable packages to provide a basis for project planning, communication, reporting, and accountability. Besides the WBS, in projects there is also the OBS (Organizational Breakdown Structure) and CBS (Cost Breakdown Structure).

A better solution to the structuring problem for risk management would be to adopt the full hierarchical approach used in the WBS. Such a hierarchical structure of risk sources should be known as a Risk Breakdown Structure (RBS).

The RBS indicates the source from which the risk has arisen. Another key characteristic of a risk is its consequence or impact having this, there is another risk-related hierarchy called the Risk Impact Breakdown Structure (RiBS).

The way I structured the RBS was by guiding myself with a generic structure of RBS from [14], I analyzed risk by risk, to see where I could insert them in the structure, making sense thus constructing a new structure.

I did the same process with RiBS, first by identifying my assets (Deliverables, Money, and People), that in level 1 the impact would be over my assets and then in level 2 would be specified depending on their risks. Level 2 of each structure was made within the formation of identifying all the risks.

Basically the **RBS (Risk Breakdown Structure)** group risks by their sources as presented in Figure 7.

And the **RiBS** (**Risk impact Breakdown Structure)** group by impact as presented in Figure 8.

RBS LEVEL 0	RBS LEVEL 1	RBS LEVEL 2
0. PROJECT RISK	1. TECHNICAL RISK	1.1 Requirements
		1.2 Estimates
		1.3 Performance
		1.4 Test & Acceptance
		1.5 Activities
		1.6 Deliverables definition
		1.7 Quality
		1.8 Skills
		1.9 Delays
		1.10 Hardware
	2. MANAGEMENT RISK	2.1 Organisation
		2.2 Information
		2.3 Communication
	3. COMMERCIAL RISK	3.1 SubContractors
		3.2 Contractual Terms

Figure 7. ISO 31000 Risk Management Process

RiBS LEVEL 0	RiBS LEVEL 1	RiBS LEVEL 2
0. IMPACT ON PROJECT	1. DELIVERABLE IMPACT	1.1 Time
		1.2 Quality
	2. COST IMPACT	2.1 Budget
		2.2 Performance
		2.3 Penalty exposure
		2.4 Changes
		2.5 Cost of ownership
	3. STAFF IMPACT	3.1 Staff morale
		3.2 Workload

Figure 8. ISO 31000 Risk Management Process

Using the RBS to structure the risk identification task provides assurance that all common sources of risk to the project objectives have been explored, assuming that the RBS is complete. The same as RiBS that will provide assurance that all common impacts on the assets of the project have been explored.

To conclude this step, the adoption of a range of hierarchical categorization frameworks within the qualitative risk assessment step can go some way towards analysing the overall risk exposure of a project. While these will not replace quantitative risk analysis methods, they do provide additional insight into where and how a project is exposed to risk. Use of qualitative categorization also has the benefit of being easy to implement, and offers a hierarchical understanding of risk not easily available from quantitative risk analysis models.

The value of this type of mapping lies in its ability to support development of effective risk responses, by revealing different aspects of the risk exposure of the project. The use of hierarchical frameworks has an additional benefit in allowing responses to be developed at different levels, ranging from whole-project generic responses to detailed specific actions targeting particular hotspots of exposure.

Step 2.3 - **"Populate the reference risk register":**

This is the last step of the proposed methodology that consists in populate the reference risk register, now with all the information we need.

Now having:

The list of risks, with all the risks that are within the scope of the project from the step 1.3;

The identifiers of the consequences and events and also with the small annotation where the risk can be found also from the step 1.3 the RBS levels (Level 1 and Level 2) from which the risk is mapped resulted from step 2.2 and the RiBS levels (Level 1 and Level 2) from which the risk is mapped also from step 2.2.

With this information, now it is possible to populate the reference risk register, the result is presented in Figure 9.

ID	Description	ID_Event	ID_Consequence	Page.Paragraph of the Risk	RBS Level 1	RBS Level 2	RiBS Level 1	RiBS Level 2
1	Payment of penalty due to the deliverables that don't reach expected quality.	1	1	208	Technical Risk	Quality	Cost Impact	Penalty Exposure
2	Low quality deliverables due to the leaving of key staff.	2	2	265.1	Management Risk	Organisation	Deliverable Impact	Quality
3	Added costs due to the changes in the requirement specification.	3	3	306.3	Technical Risk	Requirements	Cost Impact	Changes
4	Delay in the deliverable due to the Team leader new in role.	4	4	265.3	Technical Risk	Organisation	Deliverable Impact	Time
5	Delay in the deliverable due to the incompleted activities.	5	4	265.5	Technical Risk	Activities	Deliverable Impact	Time
6	Low quality deliverables due to the lack of skilled personnel.	6	2	211	Technical Risk	Skills	Deliverable Impact	Quality
7	Delay in the deliverable due to not enough people working on the project.	7	4	265.5	Technical Risk	Organisation	Deliverable Impact	Time
8	Staff are difficult to manage with unexperienced team leader.	8	5	261	Management Risk	Organisation	Staff Impact	Staff morale
9	Too many senior staff leading to increased costs.	9	3	265.5	Management Risk	Organisation	Cost Impact	Budget
10	The staff have joined the project too early due to no communication between the involved parties.	13	3	265.5	Management Risk	Communication	Cost Impact	Budget
11	Overloaded staff due to the not use of subcontractors.	10	6	269.5	Commercial Risk	Subcontractors	Staff Impact	Workload
12	Low quality deliverables due to the team members are not committed.	11	2	263.6	Management Risk	Communication	Deliverable Impact	Quality
13	Project goes into deficit due to the need to buy in services from other organizations (sub-contractor).	12	7	183.1	Commercial Risk	Subcontractors	Cost Impact	Budget
14	Payment of penalty clauses due to under-performance project.	14	1	263.2	Technical Risk	Performance	Cost Impact	Penalty Exposure
15	Delay in the deliverable due to the lack of skills of the developer.	15	4	264.5	Technical Risk	Skills	Deliverable Impact	Time
16	Changes in the budget due to the estimates are not based on solid metrics.	16	8	265.1	Technical Risk	Estimates	Cost Impact	Budget
17	Low quality deliverable due to deliverables not defined tightly.	17	2	265.1	Technical Risk	Deliverables	Deliverable Impact	Quality
18	Delay in the deliverable due to the deliverable doesn't meet the acceptance criteria defined in the contract.	18	4	263.8	Technical Risk	Test & Acceptance	Deliverable Impact	Time
19	Overloaded staff due to the staff that have other commitments with several projects.	19	6	265.5	Technical Risk	Organisation	Staff Impact	Workload
20	Increased costs due to the unreliable and poorly documented hardware.	20	3	265.7	Technical Risk	Hardware	Cost Impact	Cost of ownership
21	Delay in the deliverable due to changes in the requirements.	3	4	103.3	Technical Risk	Requirements	Deliverable Impact	Time
22	Added costs due to the low quality deliverable.	1	3	246.3	Technical Risk	Quality	Cost Impact	Budget
23	Added costs due to the delay in the deliverable.	21	3	326.3	Technical Risk	Delay	Cost Impact	Budget
24	Delay in the deliverable due to staff that do not work at the pace assumed.	22	4	261.3	Technical Risk	Performance	Deliverable Impact	Time
25	Low quality deliverable due to the staff that don't understand the developer's programming standards.	23	2	261.2	Management Risk	Communication	Deliverable Impact	Quality
26	Delay in the deliverable due to the failure to produce unit tested code by the planned date.	24	4	267.3	Technical Risk	Test & Acceptance	Deliverable Impact	Time
27	Delay in the deliverable due to the inability to begin system test on time.	25	4	267.3	Technical Risk	Test & Acceptance	Deliverable Impact	Time
28	Added costs due to the excessive performance overheads.	26	3	266.2	Technical Risk	Performance	Cost Impact	Performance
29	Overloaded staff due to the immovable end-dates.	27	6	261.7	Commercial Risk	Contractual Terms	Staff Impact	Workload
30	Demoralized staff due the customer management structure is unclear.	28	9	263.4	Management Risk	Organisation	Staff Impact	Staff morale
31	Demoralized staff due to the is difficulty to access key staff.	29	9	263.4	Management Risk	Organisation	Staff Impact	Staff morale
32	Delay in the deliverable due to the unwillingness to change working practices to fit in with the new system.	30	4	263.6	Management Risk	Communication	Deliverable Impact	Time
33	Low quality deliverable due to requirements defined in more than one document, with inconsistencies between them.	31	2	264.2	Technical Risk	Requirements	Deliverable Impact	Quality
34	Delay in the deliverable due to the difficulty in establishing tests for bought-in items.	32	4	266.2	Technical Risk	Test & Acceptance	Deliverable Impact	Time
35	Demoralized staff due to the new system that threat their jobs.	33	9	263.6	Management Risk	Information	Staff Impact	Staff morale

Figure 9. Reference Risk Register

6 CONCLUSION

IS projects are becoming increasingly complex and are subject to various risks. Risks cannot be avoided altogether but they can be managed in such a way that they are recognized and their impacts either accepted, avoided, mitigated or transferred.

The PMBOK and PRINCE2 frameworks, considered the most important frameworks on Risk Management and Project Management were analysed, with the objective to extract the most important guidance and practices on risk management processes. A set of international standards on Risk and Project Management to complement the knowledge on these areas was also considered throughout the dissertation.

The approach to managing risk on a project should be documented in a formal risk management plan or have a suitable risk management strategy.

The proposed methodology provided a set of steps and iterations on how to create a reference risk register.

This dissertation also proposed one way of structuring

the risks. There are other ideas for expanding and structuring the risk register using the identified risks like, on which parts of the project are most affected (WBS), candidate risk owners (OBS), potential cost variation and contingency planning (CBS) and the ones described in this dissertation, common causes of risk (RBS), and major types of potential impact (RiBS).

These are five ways to structure or filter a register, if we want to know the impact the various areas are having, we can analyse that in any of these items mentioned above.

It is extremely important for risk assessment to have risk register, as a support. This dissertation focuses on the importance of creating a risk register and the importance it has for organizations.

With this Structure Knowledge Base, Organizations have the power to create their own Risk Register, with their consolidated ideas, knowing the potential problems, issues that may happen during the projects, and having the structure of the risk register, for an Organization to be able to use it and profit from its benefits, following its guidelines, as proposed in my dissertation. For each project, when starting the creation of the risk register, this could be a base of work for when people working on a project could take advantage of it.

For future work, I suggest the validation of the reference risk register to an expertise panel, on the context of Project Management.

REFERENCES

[1] ISO. IEC/FDIS 31000 *Risk management - Principles and guidelines*, 2009.

[2] IEC. *Risk management – risk assessment techniques*. IEC 31010:2009, International Electrotechnical Commission, 2009.

[3] ISO. *ISO - Guide 73 Risk management – Vocabulary*, 2009.

[4] ISO Standards. http://www.iso.org/iso/home/standards.html [Online].

[5] Project Management Institute. *A Guide to the Project Management Body of Knowledge* (PMBOK® Guide). PMI Standard. Project Management Institute, Incorporated, 2013.

[6] Stellingwerf R. & Zandhuis A., *ISO 21500: Guidance on project management – A Pocket Guide*, Van Haren Publishing, 2013.

[7] Cadle, J. & D. Yeates, D., *Project Management for Information Systems* (5th edition., Harlow: Pearson – Prentice Hall, 2008).

[8] Hedmen B., Seegers R.. Van Haren Publishing. *PRINCE2 2009 edition – A Pocket Guide*.

[9] Peers K., Tuunanen T., Rothenberger M., and Chatterjee S.. *A design science research methodology for information systems research*. Journal of Management Information Systems, 2007.

[10] Van Haren Publishing. *Frameworks for IT Management*. itSMF-NL, 2006.

[11] Hedmen B., Heemst G.V., Fredriksz H.. Van Haren Publishing. *Project Management, Based on PRINCE2 2009 Edition*.

[12] Cadle, J. & D. Yeates, D., *Project Management for Information Systems* (5th edition., Harlow: Pearson – Prentice Hall, 2008).

[13] Hillson, D. *Use a Risk Breakdown Structure (RBS) to Understand Risk*s. 33rd Annual Project Management Institute Seminars & Symposium (PMI 2002), San Antonio, TX, USA , 2002.

[14] Hillson, D. *Understanding risk exposure using multiple hierarchies*, Director, Risk Doctor & Partners, PMI Global Congress EMEA Proceedings – Budapest ,2007.

[15] Hillson, D. *Using a Risk Breakdown Structure in Project Management*, Journal of Facilities Management, 2003.

[16] Hall, D. C. and Hulett, D. T. (2002) *Universal Risk Project — Final Report*, available from PMI Risk SIG website: www.risksig.com / www.techriskmgt.com/home2link.html

[17] BS ISO 21500:2012 – *Guidance on Project Management*, British Standards Institution Standards Publication, 2012.

[18] BS ISO 31100:2012 – Risk management – *Code of practice and guidance for the implementation of BS ISO 31000*, British Standards Institution Standards Publication, 2012.