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# IMPROVING RISK MANAGEMENT PRACTICE IN INDUSTRIALIZATION PROJECTS: CASE STUDY OF AN AUTOMOTIVE COMPANY

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## ABSTRACT

Project-based work is increasingly regarded as a powerful organizational response to the complex challenges of management, being an excellent way to integrate organizational functions with the expectations of stakeholders, with the aim of achieving higher levels of performance and productivity. However, the particular characteristics of projects lead them to be considered risky undertakings, making risk management one of the most important knowledge areas among project management practices.
Knowledge management is, in turn, progressively taken into account in risk management, since many of the problems underlying risk management processes arise from scarcity of information or lack of knowledge to understand the existing information. Then, within the scope of risk management, knowledge management can provide learning from past risks in order to simplify and support the management of new risks and decision-making.
The case study research methodology was applied at a plant of a first tear automotive industry supplier by using participant observation, document analysis and questionnaires to describe the current industrialization project risk management practice. Then a proposal for a risk catalog in the form of a risk database was developed to integrate information and knowledge in order to promote and support the existing and future project risk management practice.

## INTRODUCTION

Projects dealing with new product development is, in most cases, a difficult process, with considerable level of uncertainty. These difficulties and uncertainty come from its size, complexity and degree of innovation and technical sophistication of the product and also from project itself. These aspects arise, in many cases, with constraints of time, resources and external dependencies, facts that could be exacerbated by the conflicts of interest of stakeholders, increasing uncertainty and risks.
Since the project environment is a growing reality within the industrial environment, it is critical that organizations develop efficient Project Management (PM) practices in order to enable them, not only to anticipate events, but to respond to them and evolve continuously (Badewi, 2016), decreasing uncertainty and consequently some risks. Thus, with the purpose of guaranteeing the viability of business, of reducing the likelihood of project failure and make informed decisions, it is important that risks are effectively managed, through a well organized and methodical approach. The Risk Management (RM) of projects is therefore an essential part of PM, because when uncertainty and known project risks are managed, information to optimize decision-making is available (Peixoto, Tereso, Fernandes, & Almeida, 2014), contributing for project success.
The purpose of this study is to explore the RM process underlying industrialization projects, taking as research environment a portuguese plant of a leading global supplier of technology and services, responsible for producing a wide-range portfolio of electronic products, like integrated intelligent solutions for entertainment, navigation, telematics and driving aid functions. The industrialization of these products is promoted at different plants located worldwide, being this portuguese plant in Braga one of them. The industrialization process covers different stages: production of samples; manufacturing line design and production ramp-up. All of these stages are carried out by several departments which makes the industrialization projects' environment an increased challenge for RM.
Therefore, since RM is nowadays, in a globalised, competitive and volatile scenario, a critical, strategic and operational priority for some organisations (Shimizu, Park, & Choi, 2014), it is important to perform a detailed analysis of the RM pratice developed at the company in order to improve the process, focusing on the maximizing the process efficiency. For this purpose, the analysis of organizational Knowledge Management (KM) will be considered as a way to integrate information and lessons learned from the RM process with the aim of smoothing the management of risks in future projects. In addition,

industrialization projects, being a specific type of project which deal with design, requirements fulfilment, technical feasibility and other sources of uncertainty, will benefit from this investigation.
After this introduction, a theoretical background of the research topics under study is presented. Then the research methodology is presented, followed by a chapter describing the reality of the company, i.e. the research environment. The next chapter describes the structuring process of the risk catalog and the tool suggested to integrate information and knowledge from RM. Finally, in the last chapter, the main conclusions of the study and further work are presented.

## THEORETICAL BACKGROUNG

Supported by literature review, this chapter presents the state of art about the core themes of the study, namely project risk management and organizational learning, mostly through the capture of risk lessons learned.

### Project Risk Management

Globalization, alongside increasing competitiveness, introduces new challenges to which organizations need to respond, trying to be innovative betting on the introduction of new ideas and projects. This urgency of change has forced companies to rethink and reorganise their structure, their projects and systems (Karadsheh, Mansour, Alhawari, Azar, & El-Bathy, 2009), in the perspective of surviving in this competitive climate and gain advantage over other companies.
Being project-based management a growing reality in business environment, the need to manage projects effectively and efficiently to raise their chances of success and their contribution to the organization, emerges. PM has gained, in this sense, representativeness and importance, being seen as a powerful organizational response to complex challenges of management (Kwak & Stoddard, 2004; Zhai, Xin, & Cheng, 2009). However, due to its singular and temporary characteristics, the development of a project is a difficult and risky process, with some level of uncertainty. Consequently, RM has been developed over the last decades as an integral part of PM (Del Cano & de la Cruz, 2002). Several standards present guidelines on how to manage project risk, since it is one of the most important areas of knowledge among PM practice (Fernandes, Ward, & Araújo, 2013).
Padayachee (2002) defines *risk* as any variable in the project that causes its failure. It is exactly with this negative view that ICB4 - Individual Competence Baseline (IPMA, 2015) separates *opportunity* and *risk*, being the first related to positive effects and the second to threats or negative effects of occurrence of some events in project objectives. Although the term *risk* is usually linked to a negative aspect, there are other views. PMBOK - Project Management Body of Knowledge (PMI, 2017) defines *risk* as an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives, a vision shared by SBOK - Scrum Body of Knowledge (SCRUMstudy, 2016) and by ISO 31000:2009, recognizing both risk dimensions.
Some authors also distinguish *risk* from *uncertainty*. According to Kolisch (2010), *risk* represents an event or condition with a known probability of occurrence, while *uncertainty* is an event or condition for which the probability of occurrence is unknown. In turn, Ward and Chapman (2003) consider the use of the term *risk* reductive, since it is often considered as something negative and as an event, rather than a source of uncertainty.
In general, the RM process extends throughout the project's life cycle, including the following steps: RM planning; risk identification; qualitative and quantitative risk analysis; planning and implementation of risk responses; monitoring and registering of the RM process. All these activities are carried out with the purpose of increasing the probability and impact of opportunities and reducing the probability and impact of threats (Borge, 2002; PMI, 2017). This is a key process because it provides useful information and guidance to estimates, project control and decision-making (Alhawari, Karadsheh, Nehari, & Mansour, 2012; Leung, Chuah, & Tummala, 1998). Performing RM ensures that part of the problems can be timely identified, so that their occurrence doesn't cause damage on outlined project schedule or budget.

### Organizational Learning from Risk Management

RM process covers knowledge of several fields and areas (Del Cano & de la Cruz, 2002), reason why some studies reveal the managers' inability to have sufficient knowledge to manage risks in an optimized way.
In this sense, KM has been considered a positive influence on organizational risk reduction (Karadsheh et al., 2009), which has led to the introduction of KM practices in the RM process. According to Neef (2005), an organization is unable to manage risk effectively if it can not manage its knowledge. Rodriguez and Edwards (2008) corroborate these ideas, considering that RM process modeling cannot occur without a well-established KM process. This aspect strengthens the idea that information sharing is crucial to RM, since the participants in the project must have a risk shared understanding. In addition, in order to encourage the flow of information and knowledge from task to task, from process to process and from project to project, it is required that knowledge is efficiently managed.
Marshall, Prusak and Shpilberg (1996) argue that lack of organizational KM is one of the three main causes of RM failure. According to these authors, the RM problems often arise not due to information scarcity, but by lack of knowledge to understand some information. It is in this context that KM plays an important role by sharing knowledge and appropriate tools to different situations (Rodriguez & Edwards, 2008). For example, the use of lessons learned from past projects or shared learning

among the project team to reduce the chance of repeating previous failures and taking advantage of successful practices.

According to Dikmen, Birgonul, Anac, Tah and Aouad (2008), the term *learning from risk* is used to express knowledge resulting from the RM process, in which focus is given to lessons learned to improve RM practice. For Newell, Bresnen, Edelman, Sheridan and Swan (2006), the capture of lessons learned is the best way to disseminate knowledge between projects. Accordingly, several organizations foster corporate risk memory towards storing general information of risks, lessons learned about effectiveness of response strategies and factors that affect the risk consequences. Within projects, risk data repositories mean quality of the planning and estimates made for current and future projects (Atkinson, Crawford, & Ward, 2006), supporting, in turn, faster and more informed decision-making. Moreover, the existence of these databases can change the idea that RM is an optional and standalone process, to be seem as a process that contributes to project success and to better organizational performance, in a learning and growth perspective. It is therefore essential that organizations apprehend lessons to improve their processes, since the ability to learn and materialize the change has become a truly sustainable competitive advantage (Wellman, 2007).

## RESEARCH METHODOLOGY

This study aims to answer the following research question: *How to take advantage of existing information and knowledge about risks in order to promote risk management in industrialization projects?*

For this purpose, it was proposed the creation of a risk catalog in the form of a database. This objective covers more specific objectives, such as: integrate information and knowledge about risks from different project managers; support to current and future RM; promote RM practice.

In order to meet these objectives, the case study research strategy was applied to develop detailed and intensive knowledge regarding the RM of industrialization projects. The study focused on the manufacturing engineering department, specifically on the project managers of industrialization projects area. It took place between December 2017 and May 2018, being confined to a transversal time horizon. A deductive research approach was adopted, since literature allowed to identify theories to be applied at the research environment. Based on the Research Onion model proposed by Saunders, Lewis and Thornhill (2009), it was possible to identify the interpretativism as a dominant research philosophy, given the researcher's need to interpret, catalog and classify the existing qualitative data. Mixed-methods were used, such as participant observation, document analysis and questionnaires. Regarding document analysis, the organization has a wide variety of documentation, like norms, central directives, books, standards, videos and presentations, among many others, exhaustively analyzed for this study. In addition, literature review was performed to identity the kind of risk information that must be included in risk catalog.

On the other hand, participant observation of Project Managers and interpersonal contact developed by the researcher allowed the drawing of some lessons related to the company's RM process. These research methods were simultaneously used. The researcher whilst consulting the existing documents and observing the Project Managers (PjMs), performed the literature review, which enabled him to build an initial structure for the risk catalog. In addition to these activities, a questionnaire was prepared with two purposes: to gather information regarding to the RM process of industrialization projects in order to characterize the reality of the company; to collect the opinion of PjMs about the risk catalog. In parallel with these purposes, given that the initial structure of the risk catalog was constructed, the questionnaires helped the validation of the initial format. This questionnaire developed to be addressed solely to PjMs of industrialization projects was delivered in person by the researcher, between mid-April and late May. Personal contact was helpful to explain the aim of the study and to request risk information for subsequent loading of the risk database. A sample of 12 responses were collected, referring to a population of 16 PjMs.

The type of data mostly used was secondary data, namely company's documentation. Primary data was also collected, such as descriptive observations in a form of a diary in which the researcher registered some considerations about the research environment and the questionnaire data. These data allowed the researcher to meet the objectives of the study.

## CURRENT RISK MANAGEMENT PRACTICE

PMI (2017), the PM reference of the company, describes RM as a set of seven processes: (1) plan RM; (2) identify risks; (3) perform qualitative risk analysis; (4) perform quantitative risk analysis; (5) plan risk responses; (6) implemente risk responses and (7) monitor risks. The document analysis and participant observation developed by the researcher allowed to see that in industrialization projects these phases are not always carried out. In order to corroborate or refute this understanding, a questionnaire was applied to PjMs, in which they indicated the RM processes they execute. Then, Figure 1 presents the seven processes/phases of RM alongside the respective percentage of PjMs that claim to perform them on the course of their roles.


Figure 1: Most used RM processes at the company

In the PM life cycle of industrialization projects there are formal and defined moments for risk identification sessions, in many cases carried out through workshops that fulfill this purpose. The questionnaire results confirm this reality, since (2) Identify risks is the process performed by a large number of PjMs. In addition, (6) Implement risk responses is the second most performed process by PjMs, whereas the (1) Plan risk management and the (4) Perform quantitative risk analysis are the phases less performed by managers on their projects. Regarding the process (1), the research raised the need to integrate RM plan in the overall PM plan. In other words, give more attention to the RM aspects in order to construct adequate, cohesive and detailed RM plans with the aim of promoting their contribution to the process. In turn, in relation to the process (4), PjMs referred as the main obstacle for its realization the difficulty of accessing costs and additional information (e.g. frequency of the risk event; historical activities time records), which would allow reliable and realistic analyses and estimates. Thus, essentially stemming from the difficulty of accessing and crossing certain information, it is important to find ways to bridge these drawbacks in order to ensure that identified risks are treated quantitatively in relation to their impact on project objectives. Process (7) - Monitor risks - is the RM phase in which the initial understanding is more misaligned with the data obtained with the questionnaires. Since the scarcity of time is commonly pointed out as a barrier to the realization of some activities, the premise was that it is rarely performed, occurring only in cases where some risk effects are feared. Nonetheless, more than half of the sample PjMs claim to carry out this process. A deeper study should be performed to understand if the cause for the conclusion that arise from the collected data are related to not considering monitoring as a continuous activity but rather a sporadic one or, more generically, the low conceptual understanding in the matter of PM.

While the vast majority of PjMs consider that they manage the risk of their projects, it is clear the need to embed what the main standards describe and conceptualize as risk management. At the time questionnaires were delivered, only four PjMs presented documentation about the RM of their projects that was structured according to the PM standards defined by organization. According to PjMs, this is due to the fact that it is an "almost automatic and intuitive risk management", "derived from experience", which, due to the "lack of time" and "tight and mismatched with reality deadlines", is mainly performed through an "informal manner".

Given this reality, there is a need to promote and improve RM practices, through the creation of means to facilitate this process. Also, it is clear the need to support with additional information the realization of the different phases, so that they can be properly documented enabling the gathered knowledge to be used in future projects.

## DEVELOPMENT OF A RISK CATALOG

On the perspective of Stein and Zwass (1995), organizational learning is the mean by which knowledge from past events supports the running activities. In this sense, in the scope of projects, the risk data repositories facilitate the quality of planning and estimates, enabling faster and more informed decision-making. This vision is shared by the majority of plant PjMs, as resulted from the questionnaire. In fact, when faced with the creation of an integration tool for information and knowledge about industrialization project risks (risk catalog), they argued it would be a tool capable of improving their performance as PjM. On the other hand, with the existance of a risk catalog they are more motivated to manage their project risks, because it facilitates the access to information, enabling them to easily use this data in current and future projects.

In the remaining of this chapter, the steps for development the risk catalog are presented.

### Define catalog format

A risk catalog is defined as a set of information, which can be in the form of a small database or spread sheet, categorized according to their sources (Dikmen et al., 2008). So, it was relevant to explore what kind of information should be part of the catalog, which, in this case, took the form of a risk database.

One of the premises for the definition of the risk catalog format was not only to integrate existing information in a logical and standardized way, but also to add value to the company, by including new risk information and fields that document the knowledge obtained from RM processes applied in the past.

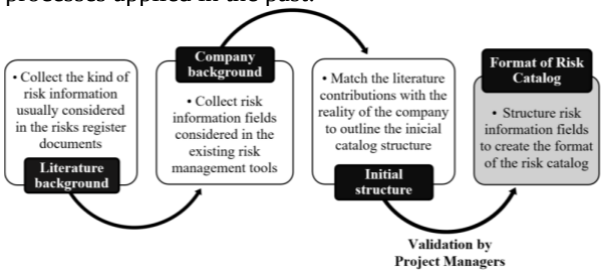


Figure 2: Process for creating the Risk Catalog format

The process for creating the risk catalog format is represented in Figure 2, in which the 5 steps underlying the catalog structure development are sequentially presented: (1) literature background; (2) company

background; (3) initial structure; (4) validation by project managers and (5) format of risk catalog.

The literature review performed allowed the researcher to go behond the types of fields covered by the existing documents in the company, understanding what contributions may be arising in relation to the kind of information that must be included in the risk catalog. Hence, it was generally used the contributions of Willams (1994), Ward (1999) and Patterson & Neailey (2002), that allowed the gathering of a list composed with 32 items, usually considered in risk register documents. About these collected contributions it is possible to note that there is an agreement among the authors regarding the relevance of some information, such as *risk description*, *risk ID*, *risk cause* and *probability*, *impact* and the consequent *severity of risk*. In addition to these, the *description of response plan*, *risk owner* and *responsible for response* are, according to the authors, informations that should be taken into account. The survey of the fields considered in the company's existing risk register tools was carried out. These fields were matched with the literature contributions, which allowed to add and to remove some items and to build a framework also made up by 32 items. Based on these items, the initial structure of the catalog was defined and presented in the questionnaire to the PjMs.

| **Risk Catalog for Industrialization Projects** |
|---|
| **1. Risk overview** |
| 1.1 Information about the project in which the risk was identified: |
| 1.1.1 Project name |
| 1.1.2 Project manager |
| 1.1.3 Project classification (A, B, C, D) |
| 1.1.4 Business unit |
| 1.1.5 Client |
| 1.2 Risk category |
| 1.3 Risk type (threat or opportunity) |
| 1.4 Source of risk identification |
| 1.5 Risk threshold |
| 1.6 Risk trigger indicator |
| 1.7 Project phase in which the risk occurs |
| **2. Risk cause and effect** |
| 2.1 Risk cause |
| 2.2 Risk event |
| 2.3 Risk effect |
| **3. Risk evaluation** |
| 3.1 Risk evaluation (inicial) |
| 3.1.1 Impact |
| 3.1.2 Probability |
| 3.1.3 Matrix score |
| 3.1.4 Expected monetary value (€) |
| 3.2 Risk evatuation (future/after response) |
| 3.2.1 Impact |
| 3.2.2 Probability |
| 3.2.3 Matrix score |
| 3.2.4 Expected monetary value (€) |
| **4. Risk response** |
| 4.1 Response strategy |
| 4.2 Response description |
| 4.3 Responsible for response |
| 4.4 Start date of response |
| 4.5 Due date of response |
| 4.6 Cost of response |
| 4.7 Effectiveness of response |
| **5. Notes** |
| **6. Risk lessons learned** |

Figure 3: Risk Catalog format for industrialization projects

Faced with this information, PjMs were asked to indicate which items would they include or exclude from the risk database, as well as suggest further elements that they consider relevant to include. After this validation, the structure was updated and the final format of the risk catalog was defined, being composed by 31 items. As can be seen, the items are organized in 6 groups of information: (1) Risk overview; (2) Risk cause and effect; (3) Risk evaluation; (4) Risk response; (5) Notes and (6) Risk lessons learned. It is essential to clarify that on the fifth group additional information about risk is presented (e.g. technical processes in which risk occurs; other projects affected by the risk; etc). In turn, the last group presents some tips and recommendations arising from management of other risks (e.g. effective ways of dealing with the risk; ways to prevent similar risks, etc.).

**Create catalog support**

Currently, Risk Catalog is supported by an Excel document with 140 risks. This risk data was manually loaded, due to the fact that only four PjMs provided the RM documentation from their projects. The idea that risk information could be compiled manually presented some advantages, since it enabled the standardization of data from the different managers, which wouldn't have happened if non-standardized data were loaded automatically. Nonetheless, in the future, with the existence of large amounts of data, it will be difficult to load risk database manually. In this case, it is crucial to think of alternative ways of doing it.

Figure 4 presents the current flow of information in the Risk Catalog.

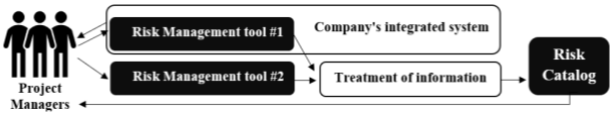


Figure 4: Risk catalog current flow of information

At present, risk information is documented by PjMs across two existing RM tools, each one feeding the catalog. However, each one writes free text, thus information is not standardized, being necessary its treatment, which is not feasible if there is a huge amount of data. In addition, although one of the tools is integrated into the general system of the company, each PjM only has access to the information documented by himself, and not to other PjM's information. As such, it is pertinent to find ways to systematize the existing risk database in order to integrate it into the existing integrated system of the company.

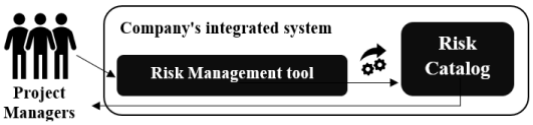


Figure 5: Future flow of information in Risk Catalog

In this way, PjMs would register risks on a single system, using the pre-defined fields of information proposed for the risk catalog. Once this was done, the data would be automatically loaded into the risk catalog, which once integrated into the general company's system would allow each PjM to easily access the information of all

PjMs, making use of all data for the management of their projects' risks.
The second part of the research is designed to work on these aspects in order to improve the risk catalog and allow its contribution to the RM process to be really effective.

## CONCLUSIONS AND FUTURE WORK

With this research, a learning-based approach is proposed to support industrialization project risk management.
The information offered by the existing RM tools is not fully standardized. The existing risk database is mostly composed by negative risks, whereas the number of positive risks identified is scarce. On the other hand, it was possible to notice that, within RM, the risk identification and the implementation of risk responses are the processes regularly performed in industrialization projects, while the planning of RM and the risks quantitative analysis are the processes that less managers claim to perform in their projects.
For PjMs that provide information related to the RM of their projects, it was possible to notice they document risk core information, such as risk event, its cause and effect, its initial evaluation, the response description and subsequent evaluation.
One of the most important considerations of the study is the need to continue promoting and improving RM practice of industrialization projects. It was explicit that the creation of new tools, such as a risk catalog it is not enough to support and improve the RM process. It is necessary to outline new ways to further instill in PjMs the importance of this process for their project success. So it is possible to antecipate that the risk catalog cannot, itself, encourage the RM practice at the company.
Therefore, risk catalog fulfils the core research objectives, presenting itself as an excellent way to integrate knowledge and information arising from RM of past projects to support the current and future RM practice. Nevertheless, it must be improved and merged within the company in order to realize its benefits. These are the main mottos of the future work.

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