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Risk Assessment and Risk Mapping

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Abstract: *This working paper aims to emphasize the complexity of the environment in which today's business is evolving, and associated risks. We will focus on methods of analysis and assessment of these risks, particularly in the context of a project. We first introduce the concept of risk in the company, by explaining that it is considered as an inseparable parameter of any project. Then, we present the general approach of risk management methods, which are based on two key phases: risk analysis, and treatment of identified risks.*
The risk management methods can be quantitative or qualitative. The ultimate goal is to establish a risk map with a probability of occurrence and impact of risk that are real and sincere.

Keywords: *Risk project, risk mapping, uncertainty, risk assessment*

I. INTRODUCTION

Today's business world is constantly changing, it's unpredictable, volatile, and seems to become more complex everyday. Uncertainty is an inherent parameter to the life of any organization. One of the main challenges for management is the determination of an acceptable degree of uncertainty to maximize value creation, objective considered as the basic premise in the concept of risk management. The uncertainty is a source of risks and opportunities that could create or destroy value. Risk management provides the ability to respond effectively to the risks and opportunities associated with the uncertainties that the organization faces, reinforcing the organization's value creation capacity. In the current global economic environment, identifying, managing, and exploiting risk across an organization has become increasingly important to the success and longevity of any business. One of the most effective tools used by the risk management, particularly to facilitate the decision-making, is risk mapping.

A risk map helps to formalize and prioritize the key risks of the firm, contributes to create, with managers, a common language on risks and facilitates the elaboration of a plan to take immediate actions. It will promote the emergence of a shared risk culture, which is a source of improved performance and greater risk prevention.

II. THE COMPANY DEAL WITH THE COMPLEXITY, SOURCE OF THE RISK

Companies are actresses of a complex and unstable economic environment. This complexity is characterized by the globalization of markets, the development of information systems and the interdependence of business, politics, social and ecological at the global level, the sharp fluctuations in the financial markets or economic conditions [Laszlo 1998].

We can add to this, the development of new technologies, shorter product life cycle, requirements for quality and specificity of increasingly stringent, the changing nature of competition, cultural changes, new techniques communication, the changing relationship of man with the work [Grasset 1996]. Given these global developments, it is necessary for the company to constantly adapt to its environment.

To understand the complexity, it is necessary to deal with the multiplicity of the system "the complexity is a web of heterogeneous components inseparably associated: it raises the paradox of the one and the many" [Morin 1990]. According to Genelot (2001), a phenomenon is complex when it's beyond our control and our understanding. The complexity is manifested to us in the guise of uncertainty, the multiple, the tangled, and unstable.

The complexity is perceived and linked to notions of unstable and uncertain. Admittedly, as Morin emphasizes that we will never have full knowledge of the complex phenomena [Morin 1990]. We are then in an unstable world, we can not have a rational view [Braech 1995]. However, the complexity should not be perceived as a constraint. As shown Yatchinovsky, complexity is a source of richness of diversity and depth [Yatchinovsky 1999], it can be a source of opportunities.

The company must integrate this notion of uncertainty in its management and control to adapt to the external environment. At that consideration of changes in outdoor environments, the company also has to deal with the complexity of managing its own developments and internal and external uncertainties [Braesh 95]. These uncertainties are sources of risk. The mastering of uncertainty, and therefore risk, allows better control of the firm. However, it is necessary to give up control everything, because it is impossible to identify all factors to consider for controlling the uncertainty [Yatchinovsky 1999].
This is in internal company risks, specifically in project risks, that we place our research.

2.1 The Project Risk: a Parameter Inseparable from Project

The risk is a "*hazard which occurrence deprives a resource system and prevents it from achieving its objectives*" [Wybo 1998]. The project risk is defined as an "*event whose occurrence is uncertain and whose manifestation is likely to affect the project objectives*" [AFNOR 2003]. It alters the project design process, and is "*the possibility that a project does not proceed in accordance with the desired objectives and processes, the difference being considered harmful*" [AFITEP 1998]. This disruption of the project includes the loss of control of the triptych cost-quality-time. The project risk is "*the possibility that a project does not run according to the forecast completion date, cost and specifications, these differences from the forecast are considered less acceptable or even unacceptable*" [Giard 1995].
These risks should be managed by the project team, including the project manager in the project management process. A project involves an approach built vis-à-vis the risks; its prototype character (or innovation), its integration in an environment that reacts involve a number of risks different in nature, size and frequency that the project manager can not ignore [Belicar 1994]. This responsibility must be borne by the project manager. The project manager, who supports the management of the project, has to:
- Set the objectives, strategy, resources and organization,
- Coordinate the successive actions and / or concomitant,
- Control at all times and in all fields and change the strategy, means and structure if an objective is changing or if the program can not be met,
- Optimize the allocation of resources to achieve the project objectives.

It is necessary to control these risks and opportunities in project management for companies. We discuss first what are the methods and project management tools available to project managers, and how risk mapping is elaborated.

III. METHODS OF RISK MANAGEMENT: GENERAL APPROACH

In numbers of companies, the risk assessment is too often fragmented, divided between different functions, which don't take into account only the risks related to their activities, with a view to protecting them.
Since 2003, to avoid failures and widespread methods of project risk management, a standard was drafted. Based on the principle "prevention is better than cure" approach project risk management defined by the FC X50-117 standard is as follows [AFNOR 03]:

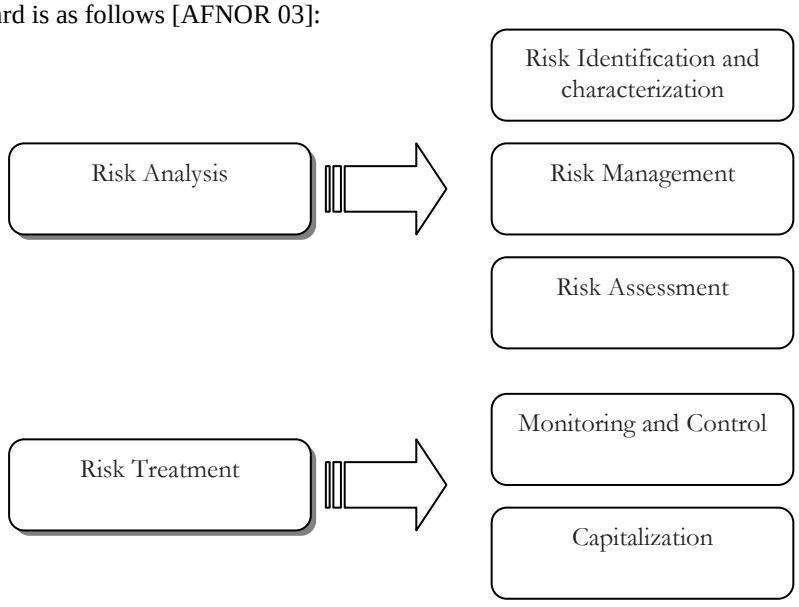

Figure 1: General approach of risk management methods

1. Risk Assessment

Desroches (2003) defines risk by its two endpoints, the occurrence and impact, "the risk is a quantity to two dimensions noted (p, g): p is a probability that gives a measure of the uncertainty that we have on the gravity effects g, in terms of damage consequential to the occurrence a dreaded event "[Desroches 2003]. Cooper, Kasenty and Navier assess the risk according to these two criteria [Cooper 1987] [Kasenty 1997] [Navier 2003].
In this evaluation phase two approaches are possible [Courtot 1998]:
- Quantitative approaches are often based on the use of the method of Monte Carlo [Kasenty 1997] [Vickoff 2000] and often require the use of a specific computer tool to decrease the importance of computing time.
- Qualitative approaches are based on the choice of a distribution according to a predefined scale of the variable and its parameters [Desroches 2003], [Navier 2003], [Chapman 2003], [Gautier 1995].
The purpose of the assessments is to allow the whole team appreciate the prioritization of risks and have a consensus on the order of actions by means of an "impartial" indicator [Chapman 2003].The precise quantification of the risk criticality is not the main purpose of risk management [Cooper 1987]. Qualitative approaches are the most common, and as Munier points out, there is no objective tool to predict risk when the feedback is low, but it is necessary to control its risk assessment scale. It should not be that the practice uses the subjective as rule of thumb that does not mention and which we do not review the operation [Munier 2003].
The assessment and prioritization of risks identified qualitatively or quantitatively are delicate and crucial. This step is essential to elaborate the risk map.

2. Typology of Risks in Project

In one project, we distinguish several types of risks depending on the chosen criterion. The major challenge is to integrate risk management and project management in a single activity. Therefore, classification of project risks must flow from the joint intervention of a domain-expert and risk-expert. This approach is based on a matrix overlap between:
- Generic risk: these are the basic families of risks apply to all projects. For example, we cite human risks, technological risks, exchange risks ... etc. ;
- Project tasks: these are the elements that make up the project. For example, we cite the supply chain task, engineering task, maintenance task ... etc.
The result of these confrontations between generic project risks and project tasks is a matrix ensuring completeness of operation. This matrix allows linking each generic risk with every component of the project description.
At the end, separate couples (generic risk / component project) emerged following the interviews of the project expert and the risk expert draft risk corresponding to real project risks which are identifiable and describable.
Risk classification is the first step to take for a better identification of project risks. However, this classification must meet two requirements:
- It must cover all potential risks. This feature guarantees the relevance and effectiveness of the adopted typology.
- It must be uniform to ensure balance in the grid and do not deprive the project risks.
That being said, it should be noted that this aspect concerning the precision and smoothness of the mesh does not condition the identification of risks itself.
The typology of the proposed generic risk is not a static model. Rather, it is a first interesting work that can be further enriched by experts and researchers of a particular technical discipline.
In the same line of ideas, a repository of risk areas was established by professionals, distinguishing between internal and external project risks.
Hereafter, we resume the typology contained in the AFNOR[1] standard.

Internal Risks:
- Human risks: organization, animation, internal communication, decision ...
- Corporate Risks: planning, monitoring, documentation, release, budget
- Technological risks: ergonomics, safety, competence, availability, adequacy
- Contractual risks: requirements, specifications

External Risks:
- Technical Risks: evolution
- Political risks: business, lobbying, social, protest
- Customer or market related risks: changing needs, competition, use
- Legal risks: safety, environment, taxation

[1] AFNOR, *Gestion du risque*,– Fascicule de documentation FD X50-117, 2003.

This typology is very exhaustive, and remains the benchmark for the professionals of project management. Several researchers have proposed risk classes to help guide the project manager and facilitate the collection of risk data incurred. In particular those of Courtot (1998) and Desroches (2003) are retained. The first one distinguishes two risk areas: organizational and human risks and risks related to project management, which are divided into 36 categories as shown in the table below.

TABLE 1: Typology of Project Risks According to Courtot (1998)

Organizational and human risks	Related to project structure	Related to principales structures		
		Related to the choice of project structure		
	Decisional risks	Related to managers behavior compared to actors		
		Related to decision making process		
	Hierarchical risks	Related to the role and activities of head office		
		Related to hierarchical relationships between actors		
	Risks related to the definition of roles and responsibilities	Related to the definition of roles		
		Related to the delegation and shared responsibility		
	Risks related to communication and information exchange	Related to behaviors of project actors		
		Related communication mechanism in place and the quality of information exchanged		
	Risks related to the capitalization and transfer of know-how	Related to capitalization		
		Related to the accessibility of expertise		
		related to the transmission of know-how		
	Conflict risks	Sources of conflict in the project		
		Evolution of sources of conflict in time		
		Evolution of sources of conflict during the project phases		
	Risks associated with management of project actors	Related to selection and recruitment of actors		
		Related to the measurement of the collective and individual performance		
		Related to training, skills management and mobilization of project actors		
		Related to the management of the project actors careers, their mobility and reconversion at the end of project		
Risks related to project management	Risks involved in project development phase	Related to the definition of work involved	Internal risks	Imprecision of tasks
				Ambiguities in objectives and priority level
				Project Inconsistency
				Technical and Technological
			External risks	policies
				commercial obsolescence
				On regulatory specifications
				Relations with partners
		Related to resources use	Definition of required resources	Regulations on resources
				Poor definition of resources
			Availability of required resources	Poor definition of the estimated production potential
				Poor management of resource use conflicts
	Risks involved in project implementation	Related to instrumentation		
		Related to late detection of problems		
		Erroneous or partial diagnosis		
		inappropriate responses		

Desroches meanwhile classifies risks into eight areas as follows:

- Development strategy
- Expression of needs and specification,
- Project organization,
- Contractual interfaces,
- Project management,
- Costs and delays,
- Technical and operational performance,
- Users and exploitation sites.

These generic checklists while very useful do not cover all risks specific to a given project.
In addition, some authors have tried to synthesize the different categories of risks the company faces. We cite particularly Pinto (2007, p. 223), who groups the risks into five categories: financial risks, technical risks, business risks, risks of execution, contractual and legal risks.

3. Risk Mapping

A risk map is a data visualization tool for communicating specific risks an organization faces.

The goal of a risk map is to improve an organization's understanding of its risk profile and appetite, clarify thinking on the nature and impact of risks, and improve the organization's risk assessment model. A risk map is often presented as a matrix. The likelihood a risk will occur may be plotted on the Y-axis while the impact of the same risk is plotted on the X-axis.

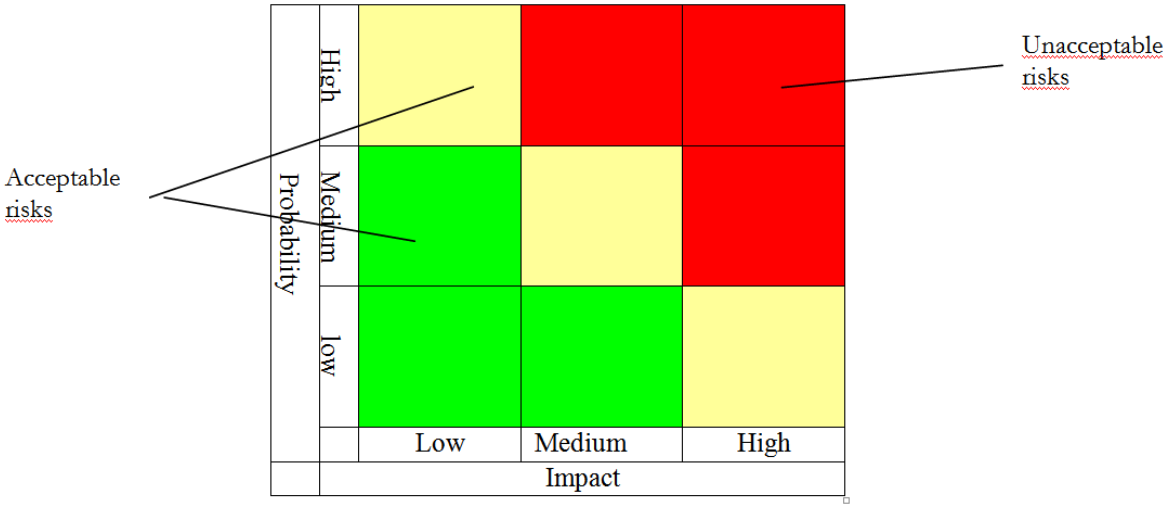

Figure 2: Example of a Risk Map

Events identified as potentially impeding the achievement of objectives are deemed to be risks and should be evaluated based on the likelihood of occurrence and the significance of their impact on the objectives. It is important to first evaluate such risks on an inherent basis-that is, without consideration of existing risk responses and control activities.

For example, an organization with headquarters on the banks of a river may seek to assess its exposure to the risk of flooding. On an inherent basis, it would consider the likelihood and impact of a flood by considering external data (such as the historical and projected frequency of floods) and internal data (such as the estimated damage to its physical assets if a flood were to occur). An impact and probability rating should then be assigned using defined risk rating scales.

These individual risk ratings should then be brought together in the form of an inherent risk map (see Fig. 2), which enables an analysis of risks not only on an individual level (e.g., high, medium, low) but also in relation to one another (e.g., a concentration of certain risks that potentially creates a greater overall risk exposure-for example, reputational damage-than the sum of the individual risk exposures). Additionally, as risk assessments are refreshed over time, a risk map can allow analysis over time (e.g., upward or downward trend of risks, and extent of positive or negative correlations between certain risks).

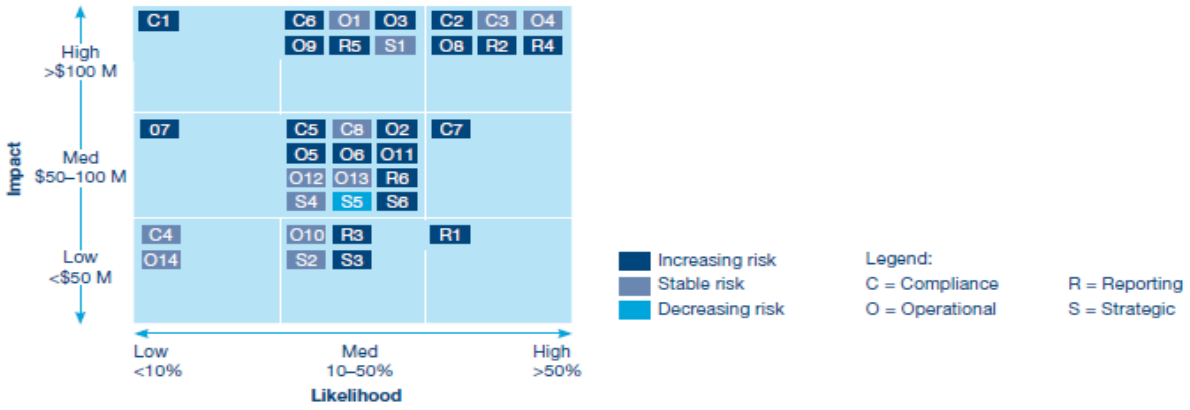

Figure 3: Risk Map[2]

TABLE 2: Risk categories

Categories	Description	Categories	Description

[2] *A practical guide to risk assessment*, Price Waterhouse Coopers, December 2008.

[C1] Compliance	Non-compliance with laws, regulations, or policies	[O10] Security	Security breaches at company sites
[C2] Ethics and integrity	Fraudulent, illegal, or unethical acts	[O11] Sourcing	Lack of access to key raw Materials, failure of supplier
[C3] Intellectual property	Inability to enforce patents and trademark, infringement	[O12] Supply chain	Failure of transportation and logistics network
[C4] Legal and disputes	Changing laws, liabilities, and commercial disputes	[O13] Technology	Development of new, potentially disruptive technologies
[C5] Product quality	Producing off-spec products	[O14] Weather	Prolonged, adverse weather conditions
[C6] Product safety	Unsafe products	[R1] Commodity	Variability and increasing trends in commodity prices
[C7] Regulatory Changing	regulations threaten competitive position	[R2] Credit	Failure of customers or counterparties to perform
[C8] Tax	Failure to adequately support tax positions	[R3] FX	Volatility in foreign exchange rates
[O1] Catastrophic loss	Major natural or manmade Disaster, terrorism	[R4] Interest rate	Variability in interest rates
[O2] Customer	Failure to follow customer preferences/needs	[R5] Investment	Financial market volatility impacts investments
[O3] Efficiency	Inefficient operations	[R6] Process design and execution	Failure in the design and execution of key management processes
[O4] Engineering	Inability to design and manage facilities projects	[S1] Alliance	Inefficient or ineffective alliance, joint venture, affiliation
[O5] Environmental	Environmental incidents or exceedances	[S2] Capital	adequacy Lack of access to capital or liquidity
[O6] Equipment	Plant equipment failure	[S3] Competitive	Actions of competitors or new market entrants
[O7] Health and safety	Health and safety incidents harm employees	[S4] Industry	Industry changes threaten industry attractiveness
[O8] IT	Failure of IT systems, cyber attack	[S5] Macroeconomic	Changes in broad economic conditions
[O9] People	Lack or loss of qualified employees	[S6] Political	Adverse actions by foreign governments

IV. CONCLUSION

The risk assessment process forms the cornerstone of an effective program to protect continuously firms. When assessments are performed systematically and consistently throughout the organization, management is empowered to focus its attention on the most significant risks and make more informed risk decisions. Organizations gain the ability to prioritize the deployment of capital and measurement of relative performance across various objectives or entities, potentially reducing the occurrence and significance of negative events, and their associated losses. Through risk mapping, organizations can better coordinate multiple risk responses, effectively addressing risks that threaten multiple business areas or functions.

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