HAL
open science

A model of project scenario evalution to monitor the level of project risk and assess the feasibility of planning

François Marmier, Didier Gourc, Vincent Robin, Séverine Sperandio

To cite this version:

François Marmier, Didier Gourc, Vincent Robin, Séverine Sperandio. A model of project scenario evalution to monitor the level of project risk and assess the feasibility of planning. 22nd International Conference on Production Research - ICPR 22, 2013, Iguassu Falls, Brazil. pp. hal-00990057

HAL Id: hal-00990057

https://hal.science/hal-00990057v1

Submitted on 5 Dec 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

A MODEL OF PROJECT SCENARIO EVALUTION TO MONITOR THE LEVEL OF PROJECT RISK AND ASSESS THE FEASIBILITY OF PLANNING

F. Marmier[1], D. Gourc[1], V. Robin[2], S. Sperandio[2]

[1] Université deToulouse, Mines Albi, Centre Génie Industriel, Route de Teillet, 81013 Albi Cedex 09, France

[2] Université de Bordeaux 1 - Laboratoire IMS, CNRS UMR 5218, 351 Cours de la Libération 33405 Talence Cedex, France

Abstract

The companies are faced with a more and more demanding market. Their ability to win contracts and bring in innovative projects is often based on some specific resources. However, several similar projects calling on the same actors or equipments, can be run in parallel within the organization. Resources are usually limited in quantity. If the needs are simultaneous, arbitration becomes necessary to prioritize projects. Therefore, the project managers must reliably know the resource requirements over the project timeline. However, few guides, books or studies on project management deal with these aspects in risky projects. The aim of this article consist in presenting the decision support system we have implemented to help project managers. The various feasible solutions are generated and modeled in a decision tree, which is connected with a model for scenario evalution. The manager is then able to evaluate, compare and choose the best way to control the level of project risk and feasibility of the planning. He will also have the information needed to negotiate the availability of resources with the various resource managers. Finally, this study discusses the case of a building project for a weather-forecasting station. It illustrates the complexity of the decision making problem and validates our approach.

Keywords:
Decision support system, organisation, project planning, resource availability, risk management

1 INTRODUCTION

In the current economic environment, companies must improve their efficiency to maintain profitability. Risks must be well controlled. However, regardless of the size of the organization or subject concerned, the projects face many risks. The more innovative the project, or if the technology area is poorly known, the more uncertain and risky the project is. Thus, the initial project planning can be very far from the achieved one. However it is on the basis of such initial planning that many decisions are made. The obtained time slots are used by project managers to assign tasks to resources and to book technical resources. However, several similar projects, using the same skills or equipment, can be run in parallel within the organization. Resources are generally limited, negotiations often become necessary. It is therefore imperative to know the most reliable possible positioning of the needs over the project duration.

More and more organizations use tools and methodological approaches to manage their projects. They help the project manager to meet deadlines, do not exceed the costs and achieve a high quality deliverables. In this context, special attention is given to methods of project management by decision makers and academics. Professional organizations and standards bodies offer guides and books on project management, best practices, etc. [1,2,3]. These documents present the processes needed to manage projects and contain the basic elements used by project managers [4]. However, few frameworks permit the integration of the impact of risks and their treatments on project planning. Resource requirements can be changed, time-shifted or suppressed. The project manager has no visibility in the real availability of resources. Therefore, the availability of resources can be out of sync with real needs.

This article is particularly interested in approaches that take into account the project risk management. Such approaches aim to anticipate potential events and measure their potential impact on the progress of a project or achievement of objectives. They allow the manager to choose treatment strategies for appropriate risk project with knowledge of their impact. Through the works presented in this article, we help the project manager to perceive the feasibility of planning, taking into account the limited availability of critical resources.

In the first section, the literature on methods of risk management shows, the diversity of existing approaches dedicated to specific areas or generic. Then, after a presentation of the model our methodology, which addresses the complexity of the choice of possible treatment strategies in the face of potential risks and the limited availability of resources, is described. Finally, a case study is detailed and we present the results and conclusions of this research work.

2 PROJECTS RISK MANAGEMENT IN ORGANIZATIONS

2.1 Project risk management and decision making process

In the literature, methods of risk management refer to a standard process with the well-known stages: identification, assessment, quantification, treatment and monitoring of risks [5,6,3]. Tixier et al. propose a classification of 62 existing approaches [7]. Methods are sorted according to the fact that they are deterministic and / or probabilistic, but also qualitative or quantitative. Gourc et al. propose a different reading grid that classify risk management approaches whether they are symptomatic or analytical [8]. The first group of approaches, also called risk-uncertainty is associated with approaches where risk management is transformed into uncertainty management [9]. The second group of approaches considers risk as an event that may affect the achievement of the project [10].

Two themes are well known for their reference to innovation and the presence of risk: (1) project management of New Product Development (NPD) at an operational level. It consists of applying project management techniques dedicated to innovative projects. It take into account a global tolerance level of the risk. (2) NPD portfolio management at a tactical level. A first definition of portfolio management is given by [11]: a dynamic of decision-making allowing the list of projects to be always up to date. In this process, new projects are evaluated, selected and sorted. Past projects may be accelerated, stopped or paused and resource assignments can be changed to build a portfolio balanced in innovative projects, following a balance risk / profitability.

2.2 Resource management in projects and organizations

Two main research axis can be found in the literature on the management of resources in project: availability and performance. Often, the project activities to be planned are subject to precedence links and specific resource assignments. So in this context, resource management techniques have to minimize different criteria, such as total duration. This is particularly the case for the problems known as RCPSP [12]. "Organization based on skills" becomes a new model of management and organization of human resources for companies [13]. This management style has an effect on the feasibility and performance of the tasks and thus on the project.

The development of projects and project resources management are influenced by company characteristics, by the network of companies and their interdependencies [14]. A decision in one of the projects conducted within the network can affect other projects in the network and thus modify their evolution. Consequently, project performance factors are not the same as those of the organization ones. Local indicators describing the projects and global indicators describing the company as a whole can then help decision makers. They know the status of internal and external organizations in terms of availability of resources and thus the capacity of the company [15] and its possible evolution [16].

In conclusion, no tools exist in our knowledge to help the project manager assessing the influence of risk and its management on the organization of activities and therefore the resources that are required by the project. Availability of resources given by the organization to the project can be unsynchronized with the positioning of the real need in time.

3 MODEL

The occurrence of risk and the modification of the project planning due to the risk treatment strategies affect schedule. Thus the time period during which the tasks will be processed can change. In order to make sure that the project would be realized, the project manager must ensure that the necessary resources will be available during the requirement periods of the project. He must therefore have a reliable vision of the needs, regarding the potential risks, in order to requests resources to the business managers. Similarly, if trade-offs between projects are required, he will need to argue his need.

3.1 Hypothesis

Some resources can be replaced more easily than others (by internal resources or external to the organization). Thus, all resources are not considered as being critical. The model we propose is based on two main assumptions:

The integration of project risk management has effects on the duration of the project and cost criteria. The effects taken into account (edit or delete an existing task or inserting new tasks) affect the project duration and cost.

In case of change or evolution of the data, the approach must be restarted on the basis of the new information. This is particularly the case during the evolution of the project where the approach may be processed before the beginning of each phase (milestones) when the information is more accurate.

At any time, the objectives of the model are to:

1. analyze scenarios and to assess the overall level of risk, ie the chance that the project meets the commitments,
2. select the best treatment strategies for anticipating and responding to a risk occurrence,
3. to book resources at the right time.

3.2 Definitions and data

A project is described by PT_t tasks $(t=1...T)$, where T is the number of tasks. The planning process provides an initial planning P_i which does not include the risks. A set of critical resources ECR is required for certain tasks.

A project is also described by its set of risks identified ER R_i $(i= 0...n)$, where n is the number of risks. Each R_i is characterized through the process of risk management. A risk R_i is also characterized by its period of occurrence, ie tasks during which the risk may occur. $proba(R_i)$ is the probability that the event related to R_i occurs. Its impact on costs is noted $CI(R_i)$ and on project duration $DI(R_i)$. Impacts can affect a task different from that characterizing the period of occurrence. These probabilities and impacts are also called initial probabilities and initial impacts.

A risk scenario ScR_S is the combination of risks that occur during a project P. A project with n risks leads to 2^n risk scenarios. ScR_S $(S=1,...,2^n)$ is a possible implementation risks with k $(0 \leq k \leq n)$. The total number of risk scenarios with k risks is equal to $n!/k(n-k)!$. The probability is noted $proba(ScR_s)$ (the probability that the events in this scenario may occur and other risks do not occur).

$$proba(ScR_s) = \sum_{i=1}^{n} \begin{cases} proba(R_i) \ if \ (R_i \in ScR_s) \\ 1 - proba(R_i) \ if \ (R_i \notin ScR_s) \end{cases}$$

Each risk can be treated in different ways: preventive, corrective or combination of both. Several treatment strategies StT_{ij} $(j = 1 ... m)$ can be identified for a risk R_i, m is the number of identified strategies. Treatment strategy StT_{ij} is a set of processing actions $A_{ij\alpha}$ $(\alpha=1...a)$ to prevent or reduce the risk, a is the number of processing actions

identified. An action can be materialized by a task to be performed that can generate three types of changes:

1. adding a new task,
2. deleting a task and the potential risks associated,
3. modification of an existing task.

A treatment strategy is a preventive strategy if it contains at least one preventive action. Otherwise, it is a corrective strategy. If the strategy consists in performing no action at all, it is noted as an empty set Ø. That means that the task is executed impacted in degraded mode (initial impact).

Finally, several treatment strategies are possible for each risk R_i. Strategies may be common to several risks. The set of the identified to StT_{ij} for a given risk R_i is noted StR_i. $StR_i = (\emptyset, StT_{i1},.., StT_{ij}.., StT_{im})$ and $Card(StR_i) = m + 1$.
A treatment scenario ScT_d $(d=1...D)$ corresponds to a combination of treatment strategies chosen to deal with the various risks of the project. The entire treatment scenarios is given *by:* $E_{ScT} = \sum_{i=1}^{n} StR_i$.
For each project P, E_{ScT} may contain a set of preventive treatment scenarios $E_{ScTprev}$ and / or corrective treatment scenarios $E_{ScTcorrec}$.

$proba(R_i \mid StT_{ij})$ is the probability that the event associated with R_i occurs, knowing that StT_{ij} (preventive strategy) was performed. The probability as well as the and impacts $CI(R_i \mid StT_{ij})$ and $DI(R_i \mid StT_{ij})$ are then called "reduced probability" and "reduced impact."

ScP_p a project scenario $(p=1...P)$ is defined as a possible achievement of the project including a risk scenario and a scenario of treatment $(ScP_p=<Pi, ScR_s, ScT_d>)$. Its duration is noted by $D(ScP_p)$. The set of project scenarios (ES) is obtained by combining all the risk scenarios, and all scenarios treatments.

$proba(ScP_p)$ is the probability of achievement of a ScP_p. It takes into account (1) the probability of the occurring risks $(R_i \in ScR_s)$, (2) the probability that several risks do not occur $(R_i \notin ScR_s)$, (3) the probability of risks occurrence $(R_i \in ScR_s)$, knowing that a treatment strategy is implemented $(StT_{ij} \in ScT_d)$ (4) the probability that R_i does not happen $(R_i \notin ScR_s)$, knowing that a preventive strategy has been deployed and that the initial probability was modified $(StT_{ij} \in ScT_d)$.

$$proba(ScP_p) = \prod_{i,j}^{R_i \epsilon ScR_s,\, StT_{ij} \epsilon ScT_d} \begin{cases} proba(R_i) & (1) \\ 1 - proba(R_i) & (2) \\ proba(R_i | StT_{ij}) & (3) \\ 1 - proba(R_i | StT_{ij}) & (4) \end{cases}$$

The cost of a project scenario is noted by $C(ScP_p)$. It includes the cost of the tasks $C(T_t)$ of the initial planning of the project, the ScR_p and the ScT_p selected and the global cost $GC^{initial}(R_i)$ of the occurring risks arising but not covered by the treatment strategies (5). Latter comprises a fixed part of the total cost (materials, tools, bulks, etc.) and an indirect cost depending on the duration of the action, on the delay and on the actors. It also includes the reduced global cost $GC^{reduced}(R_i)$ that is obtained by taking into account different strategies StT_{ij} applied to treat R_i and the reduced impact on the project cost and duration (6). Finally it also integrates the cost of the treatment strategies StT_{ij} that is determined by the cost of the actions (7). This cost consists of direct costs (materials, tools, etc..) and an indirect cost which depends on the duration of action and strategy involved.

$$C(ScP_p) = \sum_{t=1}^{T} C(T_t) + \sum_{i,j}^{R_i \epsilon ScR_s} \begin{cases} GC^{initial}(R_i) & (5) \\ GC^{reduced}(R_i) | StT_{i,j} & (6) \\ \sum_{StT_{ij} \in StR_i} C\,(StT_{ij}) & (7) \end{cases}$$

3.3 Objectives

During the preparation phase of a project, a project manager must be able to estimate the chances of project success. He must take into account the risk when determining the targets of cost and deadline. Then he has to select risk treatment strategies based on their potential to help reaching the terms of the contract.

The objective of this research is to give the project manager a method to compare different treatment strategies of risk. Risks and strategies affecting the positioning in time of the tasks, the project manager must have an indication of the feasibility of the schedules in relation to the availability of resources.

4 RESOLUTION APPROACH

4.1 A proactive approach

In an industrial context, the management of risks associated with a project is a source of many questions and thoughts since whatever the decision taken, it will lead to risks and associated impacts on the rest of the project. Our approach aims to help project actors, particularly project managers in their decision making process both during the preparation phase of the project and during the running phase. The body of the approach (figure 1) is composed of two phases:

1. generation of all possible project scenarios and their evaluation,
2. selection the best risk treatment strategies based on their ability to make the project meet the contractual commitments and their feasibility.

In the preparation phase of the project, the risk management mode must be selected. Our approach uses the classical data concerning the tasks, the risks and their associated treatment. These data are supposed to be collected on the basis of expert knowledge involved in the project. Therefore, our method has input data provided by the planning process (management team) and the process of risk management. When the project is launched, our approach can also be used when a event occurs and the project manager needs to assess the impact of the decision he must make.

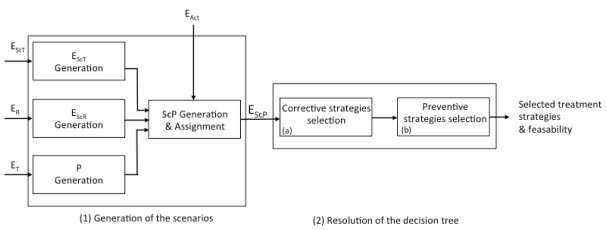

Figure 1. Proposed approach

4.2 Generation projects possible scenarios

To assess the possible project scenarios, the management team must first generate an initial schedule "nominal", without integrating the concepts of risk and risk treatment actions. From the initial planning, the experts will define the risk treatments and build all project scenarios. Times and costs will be calculated for each project scenario using the tool ProRisk [Nguyen et al., 2010]. This tool calculates the cost and duration of each project scenario, taking into account possible changes induced by the implementation

of treatment strategies. The method of calculation of the probability for each project scenario differs between project scenarios whether they include or not a preventive treatment strategy.

A comparison between the periods of availability of resources (granted by the organization, critical or not) and the periods of resource requirements (tasks of the project), the project leader and the resource manager choose the most favorable scenario, to complete the project. Thus, the initial planning is adapted depending on the scenario studied (modified task duration, tasks added or removed) and the duration of the project scenario is calculated using the PERT method.

4.3 Selection of the best treatment strategies

Based on the set of project scenarios, it is possible to adopt an opposite approach to the more conventional approaches (choice of preventive strategies and secondly corrective strategies). Decisions can be taken regarding to identified risks and associated treatment strategies: Decision D1 can be taken, knowing what would be the most appropriate decision D2 for each ScR_s (Figure 2).

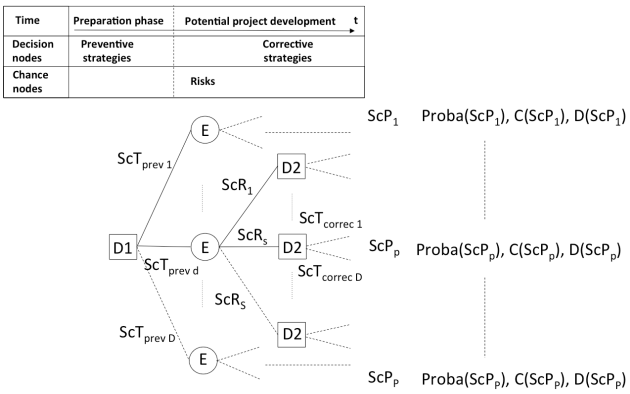

Figure 2. Decision tree

In this decision tree (Figure 2), the project management team goes through decisions represented by decision nodes D1 and D2 to reach its objectives. The first decision D1 is to select preventive strategy risk treatment. D1 would be performed during the preparation phase of the project and its consequences are included in the initial planning of the project. D2 consists in choosing the corrective actions that will be performed in front of the occurrence of all known events (risk scenario). These events are represented by the event nodes E (also called chance nodes) on the decision tree. Corrective strategies consist in selecting strategies that would avoid the scenarios that are not possible in reality, such as scenarios where the project would be stopped pending corrective action or scenarios with a NoGo situation.

The resolution of this tree is therefore in the opposite direction of its construction: D2 for each ScR_s, then D1 knowing all D2.

D2 is obtained by minimizing the criticality (details of the calculations are presented below)

D1 consists selecting the strategy that avoids the worst possible case (project scenarios) as defined by the criterion of Savage often used in decision theory [18]. It consists in minimizing the maximum criticality (also called regret) that is a measure of the regret that the decision maker could have if he had preferred action rather than another.

The criticality calculation is obtained as follows:

Each project P has a set of ScP_p and each of them can be characterized by a criticality $Cr(ScP_p)$. This measure is based on the probability of occurrence $proba(ScP_p)$, and a metric of duration and cost, respectively, α_p and β_p:

$$\propto_p = \frac{DI(ScP_p)}{\max\,(DI(ScP_p))} \text{ et } \beta_p = \frac{CI(ScP_p)}{\max\,(CI(ScP_p))} \quad (p = 1 \ldots P) \qquad (8)$$

et $\propto_p, \beta_p \in [0,1]$.

Where $CI(ScP_p)$ and $DI(ScP_p)$ are respectively the distance between [cost - duration] and the [budget - thresholds set out in the project contractual agreement]. $max(CI(ScP_p))$ and $max(DI(ScP_p))$ represents the distance from the most expensive and the longest possible project scenario.

The overall impact, and weighted normalized impact (ScP_p) is then obtained by the following formula:

$$Impact(ScPp) = q \times \propto_p + q' \times \beta_p \qquad (9)$$

Where q and q' ($q+q'=1$) are two coefficients selected by the project manager based on the importance of the duration criterion relatively to the cost one.

Then p, $Cr(ScP_p) = proba(ScP_p) \times impact(ScP_p)$ (10)

D1 is to choose the preventive strategy that is most appropriate. Preventive strategy that minimizes the maximum criticality is chosen based on the selections made in D2. For each $ScTprev_S$ the maximum criticality $CR_{max}(ScP_p \mid ScTprev_S)$ is obtained by the ScP_p associated with the given $ScTprev_S$ having the $Cr(ScP_p)$ maximum.

Thus, $\forall p$ choose $ScTprev_S$ such that $min\ CR_{max}(ScP_p \mid ScTprev_S)$

The project management team wants to maximize its chances of meeting the commitments. This methodology is a flexible tool. Results are available before the beginning of the project. In case of change or if new information is available, the approach can be processed again. It can also be restarted at each milestone for the project, for each sub-project or when an event appears or when the context changes.

5 CASE STUDY

To illustrate and validate our proposals, we propose an example taken from a case study on the construction of a weather forecast station. This project involves different business as earthwork, masonry, metal (mounting a mast / antenna wire), electronics, meteorology, etc.).. Different actors of different sectors are involved in the project. Many project data were collected from participants in the project and particularly the project manager. At the end of our case study, results are discussed with the project manager and the scenarios are compared on the basis of their effectiveness.

5.1 Presentation

The project includes 10 phases, for a total of 42 tasks (T_1 to T_{42}). The initial planning gives a horizon of 180 UT (Unit of Time). In the context of our example, we will consider two risks that may occur during the development of the task of drilling and the assembly of the antenna (table 1). Different strategies to deal with these risks are studied (Tables 2 and 3). Two critical resources are considered (Table 4), they contribute to the achievement of certain tasks and are neither replaceable nor exchangeable.

Table 1: Risks

	Probability	Period of occurrence	Initial impact time (In UT)	Treatment strategies
R_1	30%	Core drilling of the area	15	StT_{11} –Develop a maintenance plan for the core drill after the start of the project StT_{12} – Repair the core drill StT_{13} – Rent another StT_{14} – Establish a maintenance plan and rent if occurrence
R_2	20%	Assembly of the structure	5	StT_{21} – Replace an actor of the company StT_{22} – Recrut a tempory

Table 2: Treatment strategies

	Type of strategy	Action/task	Reduced probability	Modified task
StT_{11}	Preventive	A_{111} – Perform regular maintenance	20%	Core drilling of the area
StT_{12}	Corrective	A_{121} – Make repair the core drill		Core drilling of the area
StT_{13}	Corrective	A_{131} – Assign another core drill		Core drilling of the area
StT_{14}	Preventive	A_{141} – Perform regular maintenance A_{142} – Assign another core drill	20%	Core drilling of the area
StT_{21}	Corrective	A_{211} – Review schedules and assign an actor		Assembly of the structure
StT_{22}	Corrective	A_{221} – Start the recruitment of an interim		Assembly of the structure

Table 3: Treatment actions

	Predecessors	Successors	Duration (UT)	Fixed cost (UM)
A_{111}	Delineate the area	Prepare the core	1	4
A_{121}	Core drilling of the area	Study carrots	1	4
A_{131}	Core drilling of the area	Study carrots	0.2	24
A_{141}	Delineate the area	Prepare the core	1	4
A_{142}	Core drilling of the area	Study carrots	0.2	24
A_{211}	Assembly of the structure	Equipping the structure	0.2	4
A_{221}	Assembly of the structure	Equipping the structure	1	8

Table 4: The critical resources

	Tasks requiring the CR	Beginning of the availability period	Duration of the availability (UT)
Drum	Make the basement of the structure	t_0	25
Steamroller	Steam the access	t_0	13

The risk R1 described in table 1 corresponds to the premature wear of the head of the drill. If it is not replaced, the activity slowed. R_2 is the risk of injury on site during installation of the metal structure of the antenna. Its initial impact is an increase in the charge of the other team members and therefore an extension of the task.

5.2 Presentation of results

Table 5 shows the different project scenarios possible in this study. It is possible from this table to assess the

relevance of the implementation of each corrective strategy for each risk scenario in terms of criticality. Criticality of zero means that the project complies with contractual commitments.

Table 5: Set of project scenarios

N° ScP	Probability	Couple (Risk,Strategy)	Duration (UT)	Cost (UM)	criticality
1	0,64	(.,ST11)	183	4	0,000
2	0,56		180	0	0,000
3	0,24	(R1,.)	195	0	0,000
4	0,24	(R1,StT12)	185	4	0,000
5	0,24	(R1,StT13)	181	24	0,000
6	0,16	(R1,ST11)	183	4	0,000
7	0,16	(R1,StT14)	186	28	0,022
8	0,16	(.,ST11) (R2,.)	193	4	0,000
9	0,16	(.,ST11) (R2,StT21)	183	8	0,000
10	0,16	(.,ST11) (R2,StT22)	183	12	0,000
11	0,14	(R2,.)	190	0	0,000
12	0,14	(R2,StT21)	180	4	0,000
13	0,14	(R2,StT22)	180	8	0,000
14	0,06	(R1,.) (R2,.)	205	0	0,030
15	0,06	(R1,.) (R2,StT21)	195	4	0,000
16	0,06	(R1,.) (R2,StT22)	195	8	0,000
17	0,06	(R1,StT12) (R2,.)	195	4	0,000
18	0,06	(R1,StT12) (R2,StT21)	185	8	0,000
19	0,06	(R1,StT12) (R2,StT22)	185	12	0,000
20	0,06	(R1,StT13) (R2,.)	191	24	0,000
21	0,06	(R1,StT13) (R2,StT21)	181	28	0,008
22	0,06	(R1,StT13) (R2,StT22)	181	32	0,019
23	0,04	(R1,ST11) (R2,.)	193	4	0,000
24	0,04	(R1,ST11) (R2,StT21)	183	8	0,000
25	0,04	(R1,ST11) (R2,StT22)	183	12	0,000
26	0,04	(R1,StT14) (R2,.)	196	28	0,007
27	0,04	(R1,StT14) (R2,StT21)	186	32	0,013
28	0,04	(R1,StT14) (R2,StT22)	186	36	0,020

Table 6 shows the dispersion of possible outcomes of the decision to implement or not StT11 preventive strategy. It is possible to observe that the implementation of StT11 minimizes the maximum achieved criticality obtained in the worst case. It also allows to obtain a maximum overload (which characterizes the resource requirement that are not satisfied) as small as possible. Globally, over all scenarios, the cumulative non satisfied resources needs is minimized with the same treatment strategy.

Table 6: Possible project scenarios sorted by the preventive risk treatment strategies

StT_{prev}	Nbr of ScP	Nbr of ScP respecting the contract	Cumulated probability, ScP respecting the contract	Minimal criticality	Maximal criticality	Overload	Total overload
Ø	16	13	2,24	0,0	0,03	8	40
StT11	12	8	1,68	0,0	0,02	3	24

5.3 Analysis of possible decisions

The objective of this research work is to give decision makers a methodological tool to compare the impact of risks and their treatment on the project, but also to have a light on the feasibility with regard on the availability of critical resources.

The proposed approach permits evaluate the relevance of corrective treatments of risk, this whatever the context of preventive treatment implemented. Knowing which corrective treatment will be decided in all possible cases, it is possible to decide what would be the best possible preventive treatment strategy.

For each scenario, information about the feasibility are given. In a first approach it is possible to know whether the schedule is feasible with the availability granted by the organization. If it doesn't correspond, the project manager can specify the dates where critical resources are needed. If all its resources are already preempted for other projects over the periods of requirement, negotiation

can be started with the business manager. If the business manager offers different resources with different ranges of availability, the PM can select those that can best ensure the progress of the tasks for which they would be in charge knowing the potential occurrence of risks.

The example is deliberately simple for the demonstration purposes, but the behavior of the proposed approach can be extrapolated to wider problems and situations more representative of actual project.

Risks do not relate directly to critical resources. But the impact of these risks can modify the period of critical resources requirement. Risks relating to resources are then transferred on the tasks, within the framework of this approach.

6 CONCLUSION

The choice of the best strategy for dealing with the risks of a project is often difficult. When the project aims to deliver a product with technological innovations, specific resources may be required. Resources with particular characteristics are often limited in organizations. It becomes necessary to ensure that they will be available at the right time and will be used when available. We propose an approach to model and assess the impact of risks on the duration and cost of the project. This approach uses the principles of the synchronized project planning and risk management. It is based on the concepts of risk scenario, risk treatment scenario and project scenario to characterize and evaluate the effects of risks on the project. This method evaluates the overall level of risk and select the best risk treatment strategy while analyzing the feasibility. An estimate of the overall risk of the project gives an overview of possible scenarios. We illustrate the principles of our approach through a case study and a software tool has been developed.

It is often difficult to compare criteria antagonists such as compliance with contractual commitments and resource overload. The first perspective of this work is to facilitate the integration of the resource overload in the other two criteria (cost and duration). Given that different actors may be required for specific tasks, the second perspective of this research is to examine the influence of the skills required in the project in the model.

7 REFERENCES

[1] ISO10006. 1997, Quality Management. Guidelines to Quality in Project Management. International organization for standardization edition.

[2] IPMA. 1999, Competence baseline.

[3] PMI, Project Management Institute, 2009, PMBoK A Guide to the Project Management Body of Knowledge, 4th edition edition.

[4] J. R. Turner, 2000, The global body of knowledge, and its coverage by the referees and members of the international editorial board of this journal. International Journal of Project Management, 18(1), 1–6.

[5] BSI. BS 6079-3, 2000, Project management - guide to the management of business related project related.

[6] ISO31000, 2009, International Standards for Business, Risk management - Principles and guidelines.

[7] J. Tixier, G. Dusserre, O. Salvi, D. Gaston, 2002, Review of 62 risk analysis methodologies of industrial plants. Journal of Loss Prevention in the Process Industries, 15(4), 291–303.

[8] D. Gourc, 2006, Towards a general risk model for piloting goods and service related activities, Vers un modèle général du risque pour le pilotage et la conduite des activités de biens et de services. Habilitation à diriger des recherches, Institut National Polytechnique de Toulouse, Toulouse, France.

[9] S. Ward, C. Chapman, 2003, Transforming project risk management into project uncertainty management. International Journal of Project Management, 21(2), 97–105.

[10] B. Carter, T. Hancock, J. Morin, N. Robin, 1996, Introducing RISKMAN: the European project risk management methodology. The Stationery Office.

[11] R. G. Cooper, S. J. Edgett, E. J. Kleinschmidt, 1999, New product portfolio management: Practices and performance. Journal of Product Innovation Management, 16(4), 333–351.

[12] S. Hartmann, D. Briskorn, 2010, A survey of variants and extensions of the resource-constrained project scheduling problem. European Journal of Operational Research, 207(1), 1–14.

[13] E. Lawler, G. Ledford, 1992, A skill-based approach to human resource management. European Management Journal, 10(4), 383–391.

[14] V. Robin, S. Sperandio, P. Girard, 2007, Towards an integrated management of engineering design system and enterprise, In International Conference on Engineering Design, ICED 07, Paris, France.

[15] B.J. Hicks, S.J. Culley, R.D. Allen and G. Mullineux, 2002, A framework for the requirements of capturing, storing and reusing information and knowledge in engineering design. International Journal of Information Management, Vol.22, 263–280.

[16] C-J. Chen, J-W. Huang, 2008, Strategic human resource practices and innovation performance — The mediating role of knowledge management capacity, doi:10.1016/j.jbusres.2007.11.016.

[17] T.H. Nguyen, F. Marmier, D. Gourc, 2013, A decision-making tool to maximize chances of meeting project commitments. International Journal of Production Economics, 142(2), 214-224.

[18] J. Petar, 1999, Application of sensitivity analysis in investment project evaluation under uncertainty and risk. International Journal of Project Management, 17(4), 217–222.