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PROJECT RISK MANAGEMENT AS A MEANS OF ECONOMIC RECOVERY

The management of project risks and the Recovery Fund.

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"Projects:

are born in the freedom of their own ideas,

live of their own desires,

are realized by putting their skills into practice.

Therefore, we will never tell you if it is right to carry out Your projects,
Instead, we will help you to improve their quality, their sustainability,

but above all to make each project a success"

Calabrò Massey

Premise [1]

At the beginning of 2020, with the emergence of **Covid 19**, a state of emergency was declared in most EU countries. The spread of the new variant of SARS-CoV-2 has highlighted all the latent fragilities in national health systems and caused the death of about 4.55 million people in the EU alone. In addition, the lack of an effective response from the health structures and the OMS has forced the majority of European nations to institute health measures such as national lockdowns to flatten the curve of contagions; measures that, in addition to having caused the suspension of most production activities, have triggered one of the worst recessions since the Great War. To remedy this crisis, at the end of July 2020, the European Union allocated a recovery fund of 750 billion euros to boost the economies of the 27 member countries. Of this sum, 209 billion (81.4 billion as a subsidy and 127.4 billion as a loan) have been allocated to Italy alone. Thanks to the Recovery Fund, therefore, our country has an opportunity for extraordinary growth: if through the provision of such financial liquidity, it was able to implement projects in large numbers and of "quality," the GDP of our country could reach an increase of 6.5%, not just slightly higher than the European one (4.2%). Therefore, within this scenario, the only imperative is to make the best use of European funds to benefit healthy economic growth. For this to happen, it will therefore be necessary to eliminate the fragility that every project brings with it as a generator of **criticalities** and **risks** by adopting appropriate tools for the identification, analysis, and management of **project risks**. Therefore, within this framework, we see the need to evaluate and compare the different methodologies used in **project risks** management and determine which are the best solutions to use.

Summary

Abstract

This thesis aims to discuss the methodologies of Project Rating and Monte Carlo method, exposing the individual purposes, procedures, and applications that these have respectively in **Risk Management** and **Project Management**. Specifically, in addition to being exposed the technical and procedural aspects, it will also be reported and compared the different cultural aspects imposed by the approaches of reference. Once presented the two methodologies, then the work will also be directed towards evaluating the technical-economic aspects that the emergency status resulting from the covid-19 pandemic still poses as a topic of debate, and will also be discussed the opportunities and problems emerging following the allocation of the **National Recovery and Resilience Plan** (NRRP or Recovery Fund). Finally, a possible project management model characterized by the discussed methodologies and the best methodological approach to be adopted in project risk management to implement the **NRRP** consistently with achieving its objectives will be identified.

Chapter 1 – Introduction to Project Rating

1.1 Definition [2]

The necessity of operators to search for a modality that concurs the simplification of project complexities reveals the requirement to produce a synthesis able to represent the issues of the many components and subsets that compose the same

project. The Project Rating, to this end, is the right tool to use. Through its adoption, it is possible to determine the risk index of the project initiative using an innovative methodological approach based on the evaluation and analysis of the risks of the single components of the project. Today it is of fundamental importance the use of the Project Rating for the obtainment of those that are "good projects," meant as the ability to obtain in the previewed time, the greater probabilities of success in all the project phases, from the ideation up to their complete realization and management. The definition of the Project Rating is:

A **risk indicator** of a project is understood as a set of multidisciplinary subjects, which measures **its degree of problematicness**.

Risk is definable as the set of "critical issues" that have a level of "problematicness," such as being the subject of attention in the mitigation process.

Project evaluation is a complex, innovative system understood as the sum of a complex system (the project) and an innovative system that measures the result of evaluating components or subsets that generate cause-and-effect relationships.

The different rating models developed to meet the different specificities of the projects are as follows:

- Rating Operating Public Project (RaOPP),

- Rating Operating Project Loan (RaOPL),

- Rating Operating Financial Project (RaOFP),

- Rating Operating Construction Project (RaOPC).

1.2   Project Evaluation methodology [I]

Each of the four classification models follows the "Project Evaluation Methodology." The "Project Evaluation Methodology" includes the following profiles:

1.2.1   Modeling Profile

It consists of the use of the logical model for the management of Projects. The elements are:

- General flow: represents the logical schema as an operational method to obtain the project classification model.

- Archive: represents an ordered repository of project files to be kept active over time, maintaining files in an established order.

- Work Breakdown Structure (WBS): describes the project as an ordered set of "Processes" prepared according to the methodology used to evaluate the project. The WBS can be dividable into two generally organized assessment areas: economic and financial aspects (EV) and the project (PA).

- The WBS documents: the Project Rating involves the analysis of data and information in the Single File and their collection in an ordered form according to authentic documents structured according to Layout type schemes.

1.2.2 Quantitative and qualitative analysis

The compilation of the WBS documents allows for a qualitative and quantitative assessment of the data and information collected in the Layouts. The qualitative and quantitative assessment resort to the application of **ISO 31000**, which allows the assignment of scores for risk analysis.

1.2.3 Risk analysis

Through a "Risk Analysis," the risk quantification is obtained by assigning a specific score to the individual risks identified concerning the probability of occurrence and the severity of the damage. The use of **ISO 31000** allows determining the overall score of the risk to be subjected to mitigation.

1.2.4 CAC – Cluster Average Calculation

The CAC is the mathematical model through which a "final score" is obtainable as the final total value of the sum assigned to the Project quality level and the risk assessment. The CAC is used to intercept the value of the **Project Classification Index**, obtained within the **Classification Charts**.

1.2.5 Rating index

The Rating Index is the Risk indicator used to determine the level of "problematicness" of the Project and represents the "summary" of the Project's criticalities.

1.2.6 Classification Charts

The Classification Charts are of crucial importance for the Final Score - Rating Index report. Specifically, the **Quadrant Chart** allows calculating the balance between the two assessment areas (EV and PA) while the **Classification Chart** calculates the project's assessment index.

1.2.7 Final Report

Along with the calculation of the Project Rating, a final report also aims to highlight all the key features of the project that explain and validate the assigned project value.

1.3 ISO 31000 [3]

1.3.1 Introduction

ISO 31000 is an international standard published in 2009 that provides **principles and guidelines for effective risk management**. It outlines a generic approach to risk management, which can be applied to different types of risks (financial, safety, project risks) and used by any organization. The standard provides a uniform vocabulary and concepts for discussing risk management. It provides guidelines and principles that can help undertake a critical review of the risk management process. The standard does not provide detailed instructions or requirements on managing specific risks, nor any advice related to a specific application domain; instead, it remains at a generic level.

1.3.2 Principles

The standard includes several **principles**:

- creates and protects value,
- is based on the best information,
- is an integral part of organizational processes,
- is tailored,
- is part of the decision-making,
- takes human and cultural factors into account,
- explicitly addresses uncertainty,
- is transparent and inclusive,
- is systematic, structured, and timely,
- is dynamic, iterative, and responsive to change,
- facilitates continual improvement of the organization.

1.3.3 Overview

The standard is divided into three levels of analysis:

- The first level: identify the criticalities of the project as a set of many interdisciplinary components, organized by areas of evaluation, such as the technical-qualitative and economic-financial areas.
- Second level: a risk weighting as an assessment of the severity of damage that risk can produce and consequent preparation of mitigation activity.
- Third level: a to-do list that shows what and how to do to reduce or eliminate the harmful effects of risk, otherwise referred to as prescriptions.

Figure 1 shows the seven activities that the risk management process outlined by **ISO 31000** requires to apply the three levels of analysis.
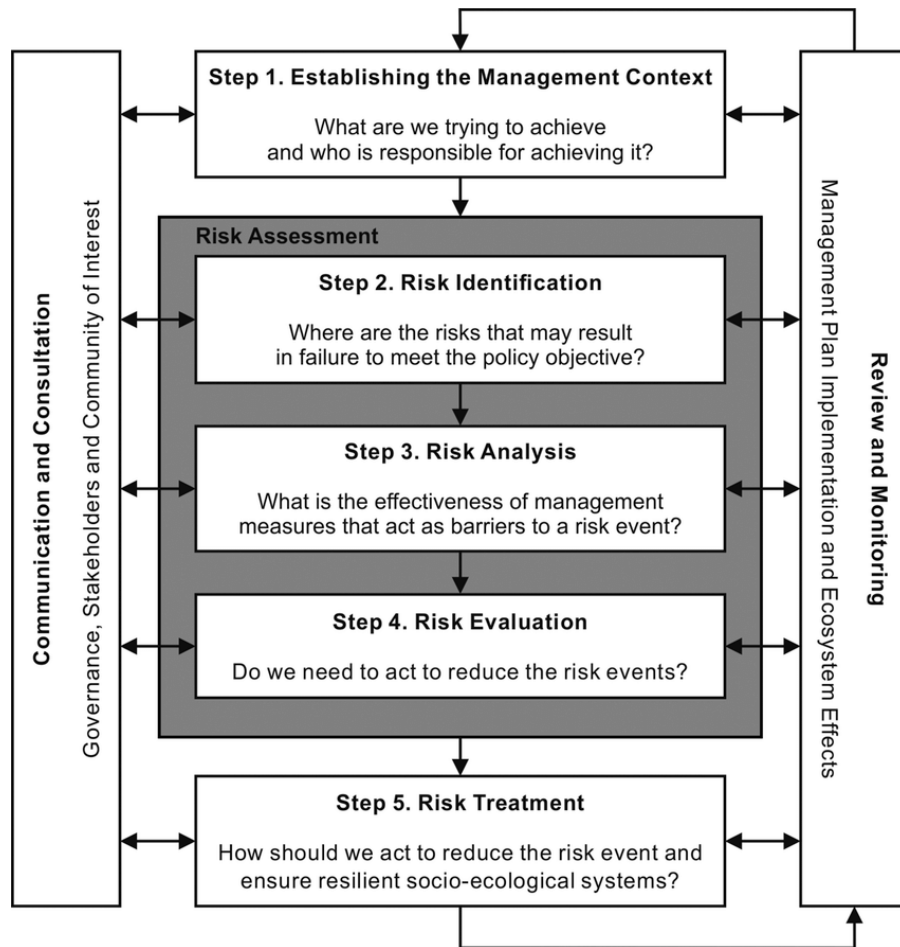
Figure 1 – ISO 31000 procedure

The reported activities can be explained as follows:

- **Risk identification**: identifying what could prevent from achieving objectives.

- **Risk analysis**: understanding the sources and causes of the identified risks; studying probabilities and consequences given the existing controls to identify the level of residual risk.

- **Risk evaluation**: comparing risk analysis results with risk criteria to determine whether the residual risk is tolerable.

- **Risk treatment**: changing the magnitude and likelihood of both positive and negative consequences to increasing benefit.

- **Establishing the context**: this activity consists of defining the scope for the risk management process, defining the organization's objectives, and establishing the risk evaluation criteria. The context comprises external elements (regulatory environment, market conditions, stakeholder expectations) and internal elements (the organization's governance, culture, standards and rules, capabilities, existing contracts, worker expectations, information systems, etc.).

- **Monitoring and review**: this task aims to ensure that controls are effective and efficient in both design and operation, obtain further information to improve risk assessment, analyze and learn lessons from risk events, including near-misses, changes, trends, successes, and failures, detect changes in the external and internal context, includes changes to risk criteria and to the risks which may require revision of risk treatments, and finally priorities and Identifying emerging risks.

- **Communication and consultation**: this task helps understand stakeholders' interests and concerns, check that the risk management process focuses on the correct elements, and helps explain the rationale for decisions and particular risk treatment options.

Since **ISO 31000** is a guideline and, as such, generalist, it needs a specific methodology to apply its general principles correctly. Therefore it is necessary to integrate this guideline with models aimed at risk management.

1.4   RaOFP - Rating Operating Financial Project [4]

The **Rating Operating Financial Project** is a rating model for construction interventions in general, whose risk purpose is project financing. This rating model has been designed explicitly for PF-PPP projects, and it is carried out through an analysis of the subject area (AS) and the project area (AP). Through the calculation of the **RaOFP**, it is possible to estimate the proper amount of financing (**K**), its repartition into equity share (**Ke**) and risk share (**Kd**), and finally, the direct amount of project revenues (**Ka**).

1.5   RaOPP – Rating Operating Public Project [4]

The **Rating Operating Public Project** is a rating model for public interventions whose risk purpose is time and cost. The **RaOPP** is a risk indicator of a project which measures the degree of problematicity concerning the two evaluation areas defined as economic area (AE area) and qualitative status of the project (AT area). The **RaOPP** allows in the ex-ante phase to identify and correct the criticalities of the project that could be reasons for disputes or delays in the awarding phase. While in the ex-post tender phase, the **RaOPP** allows precise and punctual monitoring of the site execution.

1.6 RaOPL – Rating Operating Project Loan [4]

The **Rating Operating Project Loan** is a rating model that examines the consistency of the collateral securing the Non Performing Exposure (exposure to bad debts). Employing **RaOPL**, it is possible to determine a risk index to measure the problematic level of the real estate asset placed as a guarantee for impaired credit. Then, valuable data and information are processed through its application, and the "right auction price" and probability of recovering the loan in terms of time and value are identified.

1.7 RaOPC – Rating Operating Construction Project [4]

The **Rating Operating Construction Project** is a specific rating model for the construction sector, which involves the construction of works on behalf of third parties, mainly public tenders and private initiatives. It is a project risk indicator that measures the financial risk of the project (FPR) intended as the risk of failure to repay the financing granted, which is strictly connected to the relationship between the quality of the project (project area, AP) and the financial and organizational solidity of the subject (subject area, AS). In particular, the **RaOPC** allows to predict the outcome of bankability (through the valuation of the "financial dossier") and verify if the project respects quality conditions.

Chapter 2 - Example of Project Rating RaOPP

2.1   Introduction

The following is an example of a RaOPP rating model aimed at risk analysis for public interventions of the "Real Estate" type related to the requalification, building renovation, or partial redesign of some residential buildings and services in the area the municipality of Milan. The various interventions specifically are intended for the redevelopment of the following two assets:

- Crovetto Universal City
- Sant'Erlembaldo – Villa Finzi Remix

The rating model makes it possible to plan the works to determine the project risks of the single interventions and provide a reference base to start a correct planning phase. The following paragraphs will then provide a general view of the procedural process of a RaOPP.

2.2 Procedural process

The following figure shows the first half of a Project Viewer: an interactive table showing the evaluation results of the projects analyzed using the Project Rating methodology.

Figure 2 - Project Viewer (I)

It is subdividable into five sections, but *figure 2* shows only the first ones (Asset Register and Project Register).

2.2.1 Asset and Project Register

The first step for realizing the Project Rating is acquiring project files for each intervention and the filing according to the Unique Archive (*figure 3*). Each of the documents of the related projects, once archived, will be available by clicking on the related links in the ID section of the Project Register.

File Name	WBS Code	Discipline	Data	Extension
PRJ20_001_001	P0_M1_A2_1.1_76	[PRJ]	2019-02-14	PDF
PRJ20_001_002	P0_M1_A2_2.1_77	[AET]	2019-02-14	PDF
PRJ20_001_003	P0_M1_A1_1.1_75	[ECO]	2019-02-14	PDF
PRJ20_001_004	P0_M1_A2_2.1_77	[AET]	2019-02-14	PDF
PRJ20_001_005	P0_M1_A2_2.1_77	[AET]	2019-02-14	PDF
PRJ20_001_006	P0_M1_A2_2.1_77	[AET]	2019-02-14	PDF
PRJ20_001_007	P0_M1_A2_2.1_77	[AET]	2019-02-14	PDF
PRJ20_001_008	P0_M1_A2_2.1_77	[AET]	2019-02-14	PDF
PRJ20_001_009	P0_M1_A1_1.1_75	[FIN]	2020	XLSX
PRJ20_001_010	P0_M1_A1_1.1_75	[ECO]	2020	PDF
Attachment 5 "Relazione_Corvetto"			2019-02-14	PDF
Attachment 6 "Elaborati grafici_Corve			2019-02-14	PDF
Tabels: "CIPE_rimodulato"			2020	XLSX

Figure 3 - Unique Archive

The Project Register also contains information regarding the expected project cost, the percentage share of the amount already been funded, and the type of funding. Instead, the Asset Register is a document that contains information regarding the performance of the entire asset. It is prepared at the end of analysis once each project has been evaluated according to Project Rating methodology.

2.2.2 Evaluation levels

In *figure 4* is shown the second half of the Project Viewer.

1ˢᵗ EVALUATION LEVEL				2ⁿᵈ EVALUATION LEVEL KPI				EVALUATION LEV To Do List	PROJECT PROSPECT
Phase	Critical List	Rating Index	Risk Level	Risk Outlook	Mitigation	Cost Risk	Delay [gg]	Number of Prescriptions	
P0_Pre-Fattibilità dell'Opera	Link	C	High	↑↑↑	Low Problem	6.05%	245	17	Link
P0_Pre-Fattibilità dell'Opera	Link	DD+	High	↑↑↑	Low Problem	5.04%	260	22	Link
									Link
									Link
P0_Pre-Fattibilità dell'Opera	Link	CC	Moderate	↑↑	Low Problem	3.18%	230	17	Link
P0_Pre-Fattibilità dell'Opera	Link	DD+	High	↑↑↑	Medium Problem	12.63%	275	17	Link

Figure 4 – Project Viewer (II)

At the beginning of the first evaluation, through document due diligence by experts, the project documents (of interdisciplinary type) contained in Unique Archive are examined, and information contained therein are collected to fill the WBS Documents (chapter 1.2.1). The latter being subdivided by areas of evaluation (technical and economic area) and by topic (costs, revenues, benefits, etc..) other than allowing a collection and sorting of the information, represent the basis on which analyses will be conducted to identify project criticalities. This due diligence is drafted by experts who have good experience collecting data and information and know the subjects under analysis. *Figure 5* shows an example of a WBS

Document In which it is possible to observe a lack of information regarding the various cost items.

Direct Costs

Costs	Typology	Amount	%
Redevelopment and division of housing (2 buildings 8.552,00 m²)		0.00 €	0,0%
Energy efficiency (thermal insulation on the whole complex)		0.00 €	0,0%
Removal of architectural barriers (for all ground floors of the complex)		0.00 €	0,0%
Tenant mobility plan management (64 accommodations)		0.00 €	0,0%
Design costs		0.00 €	0,0%
		15.500.000,00 €	0,0%

Indirect Costs

Costs	Typology	Amount	%
		0.00 €	0,0%

Intangible costs

Costs	Typology

Figure 5 – WBS document

When the document management phase is complete, we move on to the Project Rating calculation according to the procedure outlined in the **ISO 31000** guideline. The methodology indicated by the guideline sets out the following three levels of risk assessment:

- 1st level of assessment: Criticality analysis
- 2nd level of assessment: Risk analysis
- 3rd level of assessment: Risk treatment

2.2.3 First evaluation level

In the first level of evaluation, once the documental due diligence by experts is completed, the analysis of the information contained in the WBS Documents begins. For each WBS Document, the experts will have the task of identifying the **criticalities** contained therein, considering the lack of information and the critical values that may be a possible source of **risk**. The result obtained from the analysis will be of the type shown in the table (which shows a simplified version of a list of project criticalities).

COMPETENCE AREA	SUBJECT	CRITICALITIES	
A1_Economic Area	Costs	The documentation examined only shows the quantification of the cost at a total of €4.0 million, without a detailed estimate. In order to assess the reliability of the sum hypothesized, it is necessary to prepare a price analysis by applying parametric values using the E.P. of the Municipality of Milan or similar. The criticality found is, therefore, the absence of a C.M.E. estimate (QTE).	1. Deficient disclosure of the composition of the expected investment value.
	Revenue	The economic quantification of revenues has not been recorded. A detailed assessment must be carried out based on the fees applied by the fees applied by the Municipality of Milan.	1. Information Deficiency regarding the quantification of Revenues.
A2 Technical Area	General framework of the project	The documentation analyzed refers in general to a redevelopment of the area of occupation of the project, in terms of housing, social and safety. The documentation analyzed contains sufficient information to describe the general framework of the project,	1. Resolve and/or eliminate habitability (comfort) and accessibility issues. 2. Provide a time schedule of procedural iter reference.
	Constraints and burdens	From the documentation examined, there are no constraints or administrative burdens except for the prohibition of increasing the volume of space. It is considered necessary an in-depth examination in order to ascertain the total absence of constraints.	1. Information deficiency that prevents a proper assessment of the nature and extent of constraints and charges.

Table 1 – Critical list

As can be seen from *table 1*, criticalities present in the WBS Documents are identified and divided into competence areas and subjects. These criticalities will then be the starting point for the next level of evaluation.

2.2.4 Second evaluation level

The second evaluation level begins with the creation of a risk matrix in order to associate the respective criticalities with the project risks according to a cause-effect principle. Once concluded the association the second step consists of an analysis of the Driver In, which is a further re-elaboration in function of project risk logic of the information present in the WBS Documents. It often corresponds to the repartition of the information according to WBS Documents (like in the case taken into examination, *figure 7*), but it could be the case in which such repartition could not correspond. The analysis carried out on the Driver In is realized through a Qualitative Analysis and a Risk Analysis.

The Qualitative Analysis is implemented on the data contained within different parts of the WBS Documents and is carried out employing the "Quality Criteria." An example of Qualitative Analysis is shown in *figure 6*.

WBS DOCUMENT		DOCUMENT PART		QUALITATIVE ANALYSIS				
Code	Name	N.	Name	Detail	Criticality	Affordability	Avarag	Vote
		1	Cost Definition	4,00	5,00	8,00	5,67	Insufficiente
		2	Revenue Definition	0,00	0,00	0,00	0,00	Insufficiente
P0_M1_A1_1.1_75 Cost and benefit analysis		3	Definition of Benefits	4,00	4,00	8,00	5,33	Insufficiente
		4	Assessment of costs and benefits	0,00	0,00	0,00	0,00	Insufficiente
		5	Expense coverage	4,00	5,50	8,50	6,00	Sufficiente
P0_M1_A2_1.1_76 Project generality		1	General framework of the project	6,50	4,00	8,00	6,17	Sufficiente
		2	Characteristics of the planned intervention	6,00	6,50	8,00	6,83	Sufficiente
P0_M1_A1_2.1_77 Technical and territorial aspects		1	Technical-project description of the programmed intervention (brief description)	3,00	3,00	8,00	4,67	Insufficiente
		2	Territorial and environmental aspects	6,00	5,00	8,00	6,33	Sufficiente
		3	Urban and cadastral references	5,50	5,50	8,00	6,33	Sufficiente
		4	Outline schedule	0,00	0,00	0,00	0,00	Insufficiente
P0_M1_A1_3.1_78 Legal Aspects		1	Public bodies of interest to the work	5,00	4,50	8,00	5,83	Insufficiente
		2	List of mandatory standards and legislative constraints	5,00	4,50	8,00	5,83	Insufficiente
		3	Urban and cadastral conformity	6,00	6,00	8,00	6,67	Sufficiente
		4	Constraints and burdens	5,00	4,50	8,00	5,83	Insufficiente
P0_M1_A2_4.1_79 Sensitivity analysis		1	SWOT Analysis	8,00	3,00	7,50	6,17	Sufficiente

Figure 6 - Qualitative analysis

The "Quality Criteria" is a specific evaluation criterion that assigns a grade whose average defines the final score intended as an overall judgment of the document under examination. The evaluation criteria are:

- Level of detail: this consists in making a qualitative judgment deriving from an assessment of the "information detail" available regarding the composition and degree of the description of the data and information contained in the document under review.

- Level of criticality: consists of making a qualitative judgment of the criticalities detected following the evaluation of the data and information in the document under review.

- Reliability level: this consists of making a qualitative judgment on the capacity for an in-depth examination of the data and information in the document under review.

The Risk Analysis instead allows the quantification of the risk. This analysis is obtainable by applying the Risk Criteria, which consists of assigning a specific score to the individual risks detected based on the combination of the probability of occurrence and the severity of the damage.

The sum of the scores obtained from the two risk analyses represents the total score assigned to each WBS Document. In order to obtain the overall Driver In values for each area of competence, recourse is made to CAC (Cluster Average Calculation), a mathematical model based on the use of weighted average and which makes use of a nesting system. In *figure 7* is shown the computation of a Driver In starting from results coming from a Qualitative and Risk Analysis.

DRIVER		WBS DOCUMENT		ANALYSIS				FINAL GRADE			
Code	Name	Code	Name	Part	Qualitative	Risk	Total	Aritmetic Av	eighted Avara	Total Driver	Total Area
DR_1	Economic aspects of the project	P0_M1_A1_1.1_75	Cost and benefit analysis	1	5.67	-0.64	5.03	2.70	2.70	2.70	2.70
				2	0.00	-0.64	-0.64				
				3	5.33	-0.80	4.53				
				4	0.00	-0.80	-0.80				
				5	6.00	-0.60	5.40				
DR_2	Technical aspects of the project	P0_M1_A2_1.1_76	Project generality	1	6.17	-1.60	4.57	5.54	1.39	5.00	5.00
				2	6.83	-0.32	6.51				
		P0_M1_A1_2.1_77	Technical and territorial aspect	1	4.67	0.00	4.67	3.32	0.95		
				2	6.33	-3.20	3.13				
				3	6.33	-0.20	6.13				
				4	0.00	-0.64	-0.64				
		P0_M1_A1_3.1_78	Legal Aspects	1	5.83	-0.36	5.47	5.86	1.67		
				2	5.83	-0.36	5.47				
				3	6.67	0.00	6.67				
				4	5.83	0.00	5.83				
		P0_M1_A2_4.1_79	Sensitivity analysis	1	6.17	-0.64	5.53	5.53	0.99		

Figure 7 – Driver In computation

Once the Driver In value has been calculated, we move on to the calculation of the Driver Out, which is none other than corrective coefficients belonging to the CAC model finalized to the contextualization of the project in function of the social, economic, and bureaucratic-administrative context. As Driver In, It corresponds to

a re-elaboration of the information contained in the WBS Documents. Therefore, with Driver Out, it is possible to evaluate how the criticality of the bureaucratic-administrative, social and economic contexts changes according to the external environment. For example, how the bureaucratic procedures are influenced by the region in which the project is planned to be carried out or how the territory's characteristics may affect project implementation. These corrective coefficients are nothing more than a correction of the Driver In value previously obtained. This evaluation is carried out through a qualitative and subjective method by experts following the Driver Out information examination. The analysis consists in associating a percentage impact range on the project (five corresponds to an impact of 100% and one corresponds to an impact of 20%) to the criticalities of which Driver Out is composed. In particular, if the Driver Out value is positive, it indicates an improvement in the quality of the project according to the reference context; if it is negative, it indicates a worsening. As shown by looking at *figure 8*, the value taken as a reference for each of the contexts examined will be the average value of the reference range. As in the case of Driver In, the final value will be calculated using the CAC calculation methodology.

Evaluation of the "contexts" of competence	Driver Out impact range	Maximum Value	Minimum Value	Average Value	Total DR_FE_1
DR_FE_1. *Social context*	5 4 3 2 1 0 -1 -2 -3 -4 -5	1.00	-2.00	-0.50	
DR_FE_2. *Economic context (GDP)*	5 4 3 2 1 0 -1 -2 -3 -4 -5	2.00	-1.00	0.50	0.17
DR_FE_1. *Bureaucratic and administrative context*	5 4 3 2 1 0 -1 -2 -3 -4 -5	2.00	-1.00	0.50	
				TOTAL DRIVER OUT	0.17

Figure 8 – Driver Out computation

Then to calculate the total value of the Driver net of the Driver Out (right-hand column *figure 9*), the values of the two Drivers previously obtained for both areas of competence are added together. Finally, to calculate the value of Driver In and total Driver, the sum of the products between the value of the Driver of each area of competence and its percentage incidence is carried out.

Competence Area	Incidence %	DRIVER IN	DRIVER
A1_Economic Area	50%	2.70	2.87
A2_Technical Area	50%	5.00	5.16
		3.85	**4.02**

Critical Point	PROBLEM
Rating Index	C
Problem Level	MEDIUM-HIGH

Figure 9 – Rating Indices computation

The Drivers' values thus obtained are then used to find the values of the Rating Index, the Critical Level, and the Critical Point of the project using the Quadrant Graph and the Rating Graph shown in *figure 10* and *figure 11.* In particular, the Zone Graph shows in which technical areas of the project the most criticalities were identified through the intercept of the values of the total Driver for the two areas of competence; while in the Rating Graph, always through the total Driver value, it is possible to find the values of the Rating Index and the Critical Level of the project.
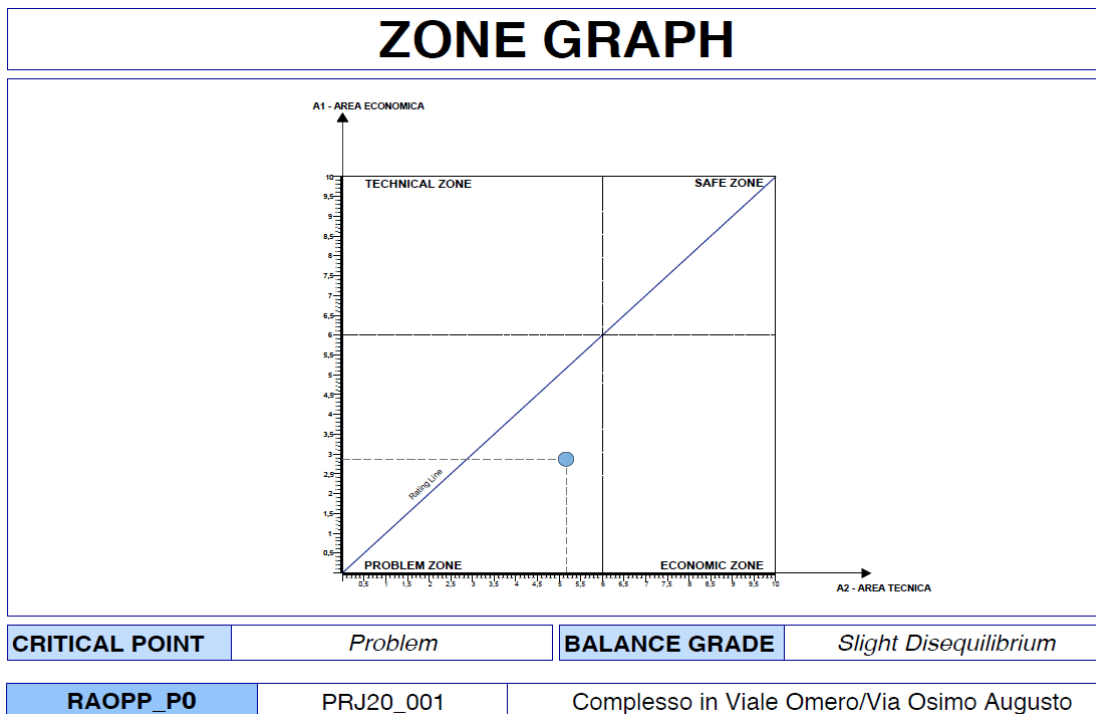
ZONE GRAPH

CRITICAL POINT	*Problem*	BALANCE GRADE	*Slight Disequilibrium*
RAOPP_P0	PRJ20_001	Complesso in Viale Omero/Via Osimo Augusto	

Figure 10 – Zone graph

RATING GRAPH

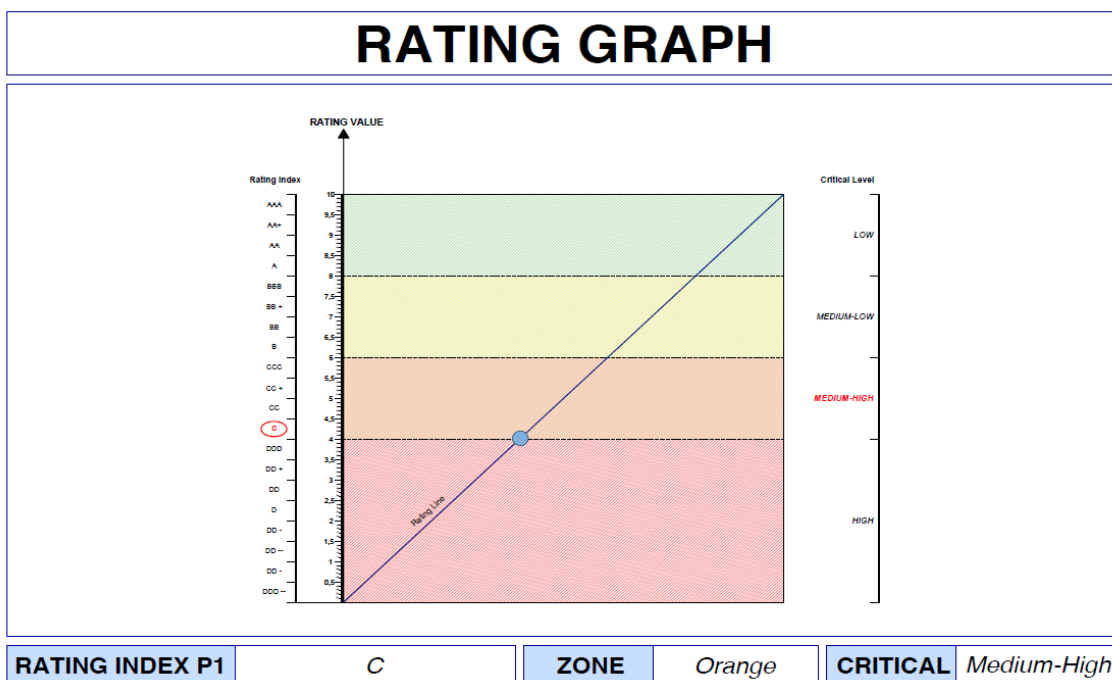| RATING INDEX P1	*C*	ZONE	*Orange*	CRITICAL	*Medium-High*

Figure 11 – Rating graph

As established by ISO 31000, once ended the **risk analysis phase** and identified the risk levels of each of the risks under analysis (shown in *figure 31*), the next step is the **risk mitigation phase**. During this phase, detailed Cards are reported once the project mitigation actions have been identified and analyzed, so to indicate:

- the general information of the risk,
- the mitigation percentage (it indicates the probability expressed in % that the mitigation action may have an impact on risk),
- the mitigation tool assigned to it,
- the mitigation target with the relative priority,
- a program that determines the time required to implement an action to eliminate the criticalities encountered (chronogram).

In Chronoprogram, on the other hand, in addition to some of the information already present in Risk Cards, the values calculated of the impacts (target) that mitigation actions have on respective risks are reported.

Figure 12 and *figure 13* show an example of a Risk Card and Chronoprogram.
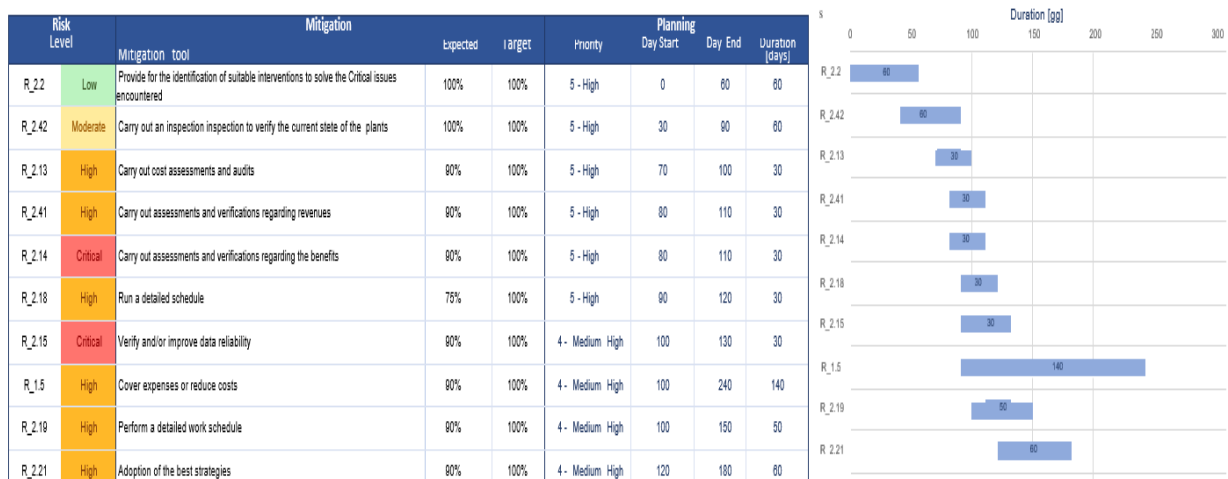
Figure 12 – Risk card

Figure 13 – Chronoprogram

Finally, the effects of risk mitigation for the project cost and time increment item are calculated considering the change due to the mitigation actions (*figure 14*). The resulting delay estimate will be reported in the Delay section of the Project Viewer.

Project Costs   4.000.000,00 €

	Without Mitigation	With Mitigation
Risk level	Moderate	Very Low
Risk level (value)	-3,68	-0,61
Cost increase (%)	36,80%	6,05%
Cost increase (value)	1.472.000,00 €	242.133,33 €
Final Costs (value)	5.472.000,00 €	4.242.133,33 €

Figure 14 – Cost risk

2.2.5 Third evaluation level

In the third level of evaluation, actions to be undertaken as a consequence of mitigation actions are made explicit. In the **To-Do List**, are reported the prescriptions (punctual and specific activities for each risk) whose task is:

- contain or eliminate project risk,
- improve the quality level of the project.

In *figure 15* is reported an example of **a To-Do List** for an economic area.

MATTER	CRITICALITY		MITIGATION TOOL	LEVEL OF RISK	CAPACITY OF MITIGATION	REQUIREMENTS	
Costs	The documentation examined reports only the quantification of the cost in total 4.0 M€, without a detail of estimate. In order to assess the reliability of the hypothesized sum, it is necessary to prepare a price analysis by applying parametric values by applying the E.P. of the Municipality of Milan or similar. The criticality encountered is therefore the absence of a C.M.E. of estimation (QTE).	1. Lack of information on the composition of the value of the intended investment.	Carry out cost assessments and audits	High	90%	1	prepare a QTE, with a CME with approximate quantities but deriving from schemes and / or design documents at a scale of not less than 1: 1,000 and with estimated unit prices obtained by applying the EP of the Municipality of Milan or similar.
Revenues	The economic quantification of revenues was not recognised. A detailed assessment should be made on the basis of the rees applied by the Municipality or Milan.	1. Lack of information regarding the quantification of Revenues	Carry out assessments and verifications regarding revenues	High	90%	2	Evaluate the revenues in relation to the rents out to be and those that can be recalculated following the intervention

Figure 15 – Prescriptions

The Project Viewer also provides the Project Prospect (accessible through the appropriate link) to summarize the analyzed project results, possible feasible strategies, and future prospects.

Chapter 3 - Project Rating remarks [5]

3.1 Overview

From what has been said in the previous chapter, it is possible to highlight that the procedure that distinguishes the Project Rating can be divided into three steps:

1. The first step: is the one that starts from the project intended as the result of a set of documental-interdisciplinary files and foresees the execution of documental due diligence by experts of the various technical areas of which the project is composed. The aim of this first phase is precisely that of identifying, as objectively as possible, the presence of criticalities within the project files in order to identify the possible manifestations of risk associated with them.

2. The second step: the methodology aims to conduct a subjective assessment to detect the cause-effect relationships that associate the respective criticalities with the project risks.

3. The third step: consists of identifying the risk values through a qualitative-quantitative analysis and a mathematical model of the CAC type (chapter 1.2.4). The rating indices and the final values of time and cost of the project will be calculated from these.

From this, analyzed the procedure more in detail, it is possible to observe that it is prevalently founded on valuations of objective type, as exposed in the first and third steps of the procedure, and only in part subjective, seen the subjectivity with which it is possible to establish the relations cause-effect inside the matrix of risk.

From all this, it must be stressed that precisely this objectivity, obtained following the presence of a methodological approach aimed at risk management (as envisaged by the Risk Management processes), is the reason for the methodology's accuracy. Therefore, given the importance of this inherent feature of Risk Management methodologies, it will be essential to emphasize how crucial these

are for implementing good projects. This importance will be highlighted later, once the National Recovery and Resilience Plan is introduced.

3.2 Reference regulations

The Project Rating adopts national and international guidelines on project management and risk management.

General regulations:

- ISO 31000:2009: is a technical specification used in risk management in various fields of application. It is a risk management methodology to be adopted in construction. It is subdividable into levels of analysis (criticalities analysis, risk analysis, and risk treatment).

- ISO 21500:2013: The standard is a guide for project management used by any organization, public, private, or community, and for any project, regardless of complexity, size, or duration. At a high level, the standard describes the concepts and processes that constitute best practices in project management.

Specific regulations:

- UNI 11648:2016: The standard defines the requirements related to the professional activity of the project manager, equivalent figures who manage

projects, or other organizational roles that perform equivalent functions by the UNI ISO 21500.

- UNI 11453:2017: guideline that defines a working methodology and allows to collect and reorganize the many information and data of a technical-design-financial type according to a precise relationship between project phases and financing process. It applies to the Italian construction sector, and it is addressed to all the operators of the sector, in particular to public bodies as promoters of the initiatives of public competence, to Construction Companies, for private and PPP-PF type Initiatives, to Credit Institutions as subjects in charge of providing financing and issuing guarantees as well as professionals and universities.

Chapter 4 - Monte Carlo method [II]

4.1 Introduction

Monte Carlo Analysis is a project risk management technique used in Project Management to conduct a quantitative analysis of risks. It is a statistical analysis applicable in all situations where there are very uncertain project estimates, aiming to reduce the uncertainty through a series of simulations. The Monte Carlo method purposes are:

- identify the level of risk in achieving objectives,

- determining the impact of the identified risks,

- finding a range of results.

Usually, the user can decide to run a certain number of project simulations, and the software determines a different scenario for each simulation based on the inputs entered. Recording the results, the user can therefore have a perspective of those that can be the possible future scenarios of the project if he decides to proceed with the start of the same.

4.2   Monte Carlo simulation

In a Monte Carlo simulation, the project model computation can occur many times. At each iteration, input values are randomly chosen from probability distributions that reflect the aleatoric nature of the input variables and whose variability is due to project risks. Once the software has performed many iterations, the Monte Carlo simulation generates hundreds or thousands of results showing values in the output graphs displayed at the end of the computation. In performing the analysis, not all the inputs are considered in the computation of a specific output variable: for example, only the schedule network diagram and duration estimates are used for a schedule risk analysis. The simulation output graphs illustrate a probability distribution for the project and the probability of reaching specific values for each output variable considered. Moreover, In Monte Carlo simulation, it is also possible to model interdependent relationships between input variables. Accuracy needs to represent how, in reality, changing the values of some factors, others go up or down accordingly.

In this chapter, the Monte Carlo Simulation will be analyzed with the algorithms proposed by Risky Project software, which is the most widely used software in Project Management for the study and analysis of projects.

4.2.1   Input variables

The definition of the input variables is a fundamental part of the simulation. The first input the model needs is the project schedule, which shows activities plan over time. Next, once that have been established the activities to be performed and their relationships specified, the software will prompt the user to enter a maximum, minimum, and baseline value for each activity, as shown in *figure 16.*
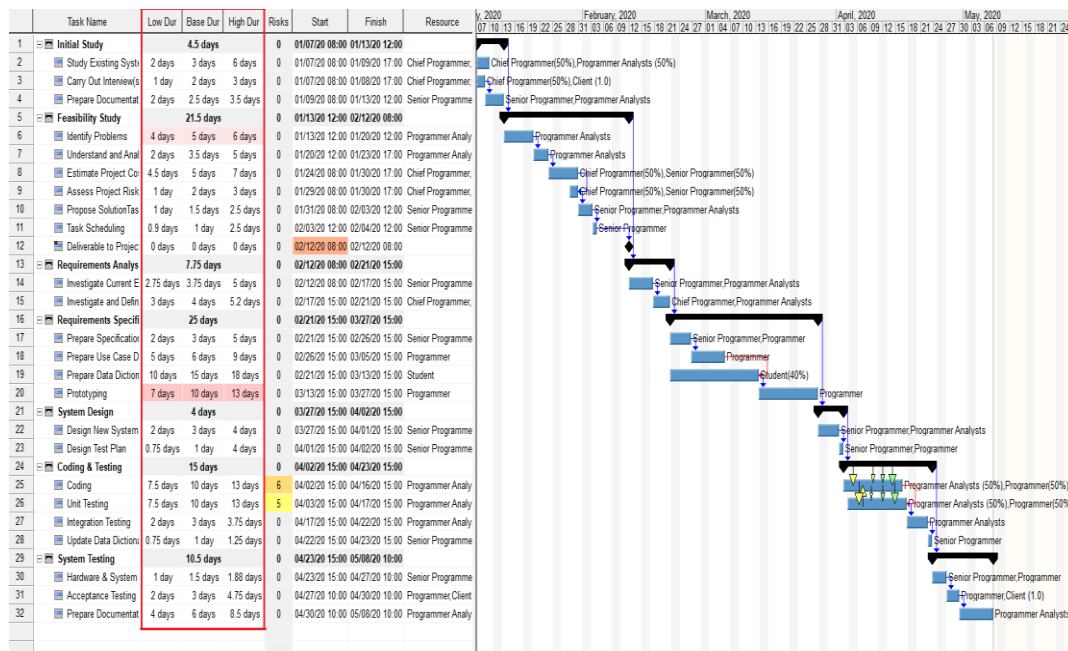
Figure 16 – Project schedule

Subsequently, Risky Project requires to user to enter for each task the probability density of:

- Cost
- Profit (only if present)
- Duration
- Starting time.

To do this, the user only has to click on the activity of interest, and the window in *figure 17* will open. From here, the user will have the possibility of selecting the distribution he considers most corresponding to the real one of the activity in question, choosing from a series of distributions made available by the program.
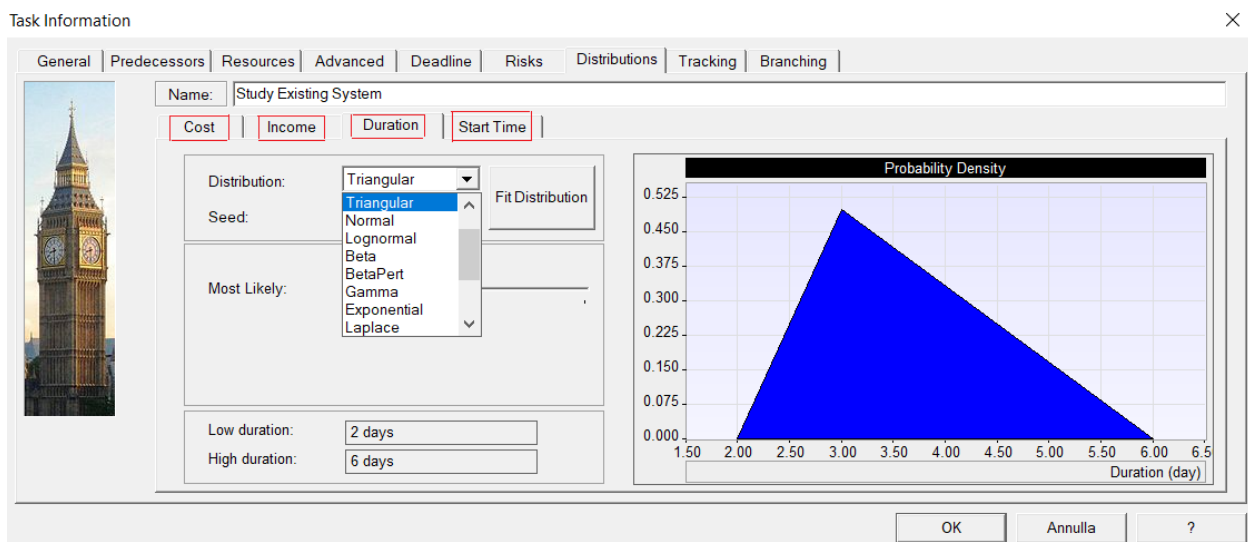
Figure 17 – Activity settings

In order to account for the variation of working days in a year, the software allows the user to consider a variable number of working days to make the simulation as accurate as possible. Using a probabilistic calendar, Risky Project allows the user to: indicate the probability that a *month* will be non-working, or establish for each month a range of non-working days so that at each iteration of the Monte Carlo simulation a different scenario in terms of the number of monthly working days occurs. Once defined the schedule, the risk register has to be filled in for the project risks. The user can set the risks so that their impact is on the whole project, for a single task, for a specific resource, or all resources. Also, the probability of occurrence, outcome, and type of risk must be provided as input for the software to consider them. Once entered the risks, the software calculates impacts that each of them has on the project as a whole or activities or resources of reference, multiplying the value of the score obtained by cost. Then, the risk is ready to be mitigated, and the user can select the "mitigation" button from the window of the risk under analysis and set the mitigation action that he thinks can be taken to reduce its impact. When the user has completed the risk register, it will appear as in *figure 18*.

	Risk Name	Oper	Risk/Issu	Threat/C	Risk Assigned To	Pre-Mitigation				Cost (Pre	Cost (Mitigation)		Post-Mitigation			Description
						Prol	Impac	Sco	Score				Prol	Imp	Sco	
1	OBJECTIVE DEFINITION	Open	Risk	Both	Assigned to 2 tasks/res	38.0%	73.4%	27.9%		€ 7,032.24	€ 700.00		15.0%	50.0%	7.5%	
2	HACKING	Open	Risk	Threat	All tasks (global)	16.0%	43.7%	7.0%		€ 3,697.91	€ 5,000.00		7.0%	13.1%	0.9%	
3	EMPLOYEE HEALTH	Open	Risk	Threat	All tasks (global)	14.0%	10.7%	1.5%		€ 1,886.78	€ 600.00		3.0%	25.7%	0.8%	
4	OBJECTIVE CHANGES	Open	Risk	Threat	Assigned to 2 tasks/res	4.2%	25.8%	1.1%		€ 1,979.46	€ 600.00		2.0%	11.6%	0.2%	
5	POTENTIAL LAWSUITS	Open	Risk	Threat	All tasks (global)	2.0%	8.9%	0.2%		€ 0.00	€ 3,500.00		2.0%	19.3%	0.4%	

Figure 18 – Risk register

During the Monte Carlo simulation, the software will consider whether or not it is appropriate to take such actions. Moreover, as far as the functionality of the Risky Project is concerned, it is worth noting the possibility of setting the exclusive outcome alternatives with the respective probability of occurrence for each risk. In *figure 19*, for example, the relative probabilities of an activity incurring risks of different types are shown.

Figure 19 – Risk settings

4.2.2 Output

4.2.2.1 Total cost, completion date and duration

Once the simulation has been executed, it is possible to understand how likely the project goals are to be achieved by considering the risks. In this regard, Monte Carlo simulation provides the values of the current schedule and the low, base, high duration for:

- The total cost of the project
- The completion date of the project
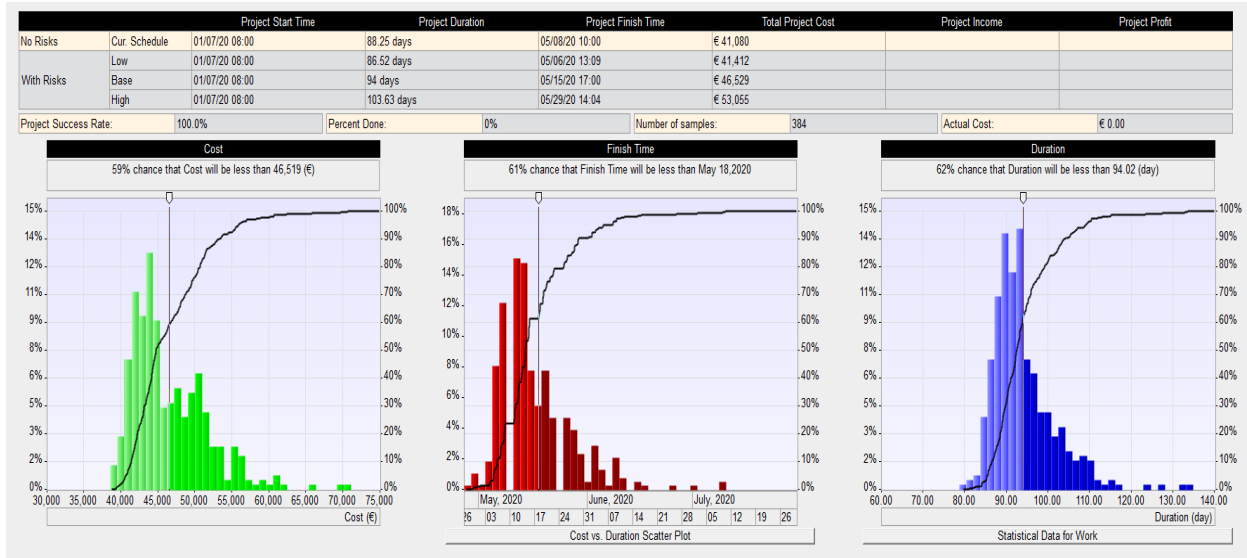- The duration of the project.

Figure 20 – Histograms of outputs

The histograms show the statistics of each simulated scenario that has been obtained from the Monte Carlo simulation. Once it has been carried out, to clarify the results of each task, Risky Project allows to graphically display for each task, in addition to the statistics for variable cost and labor, the statistics in *figure 21*.
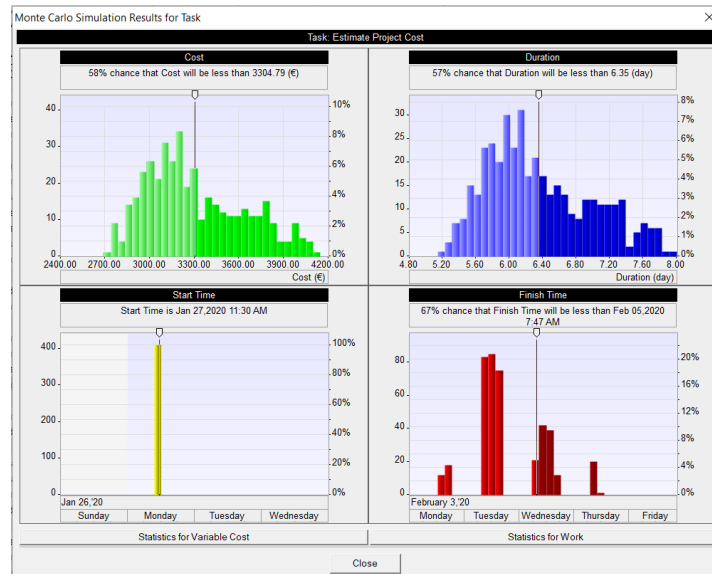
Figure 21 – Histograms of outputs of an activity

As far as project parameters are concerned, Risky Project provides relevant data regarding time and cost. By providing a ratio between data that considers risks and those that exclude them, it is possible to obtain scores that evaluate the percentage increase or decrease in project results due to the impact that risks/opportunities had on it. Specifically, Risky Project lets users view the following scores in the form of a dashboard.
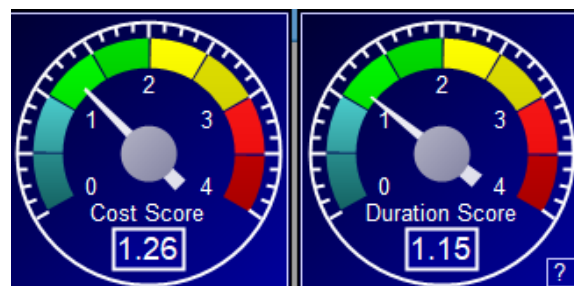

Figure 22 - Dashboard

4.2.2.2   Gantt

Risky Project allows users to visualize the uncertainty regarding the schedule, i.e., the range within which a given activity can start or end due to project risks, employing a Gantt. In order to do it, the Risky Project depicts at the ends of each task figures similar to small blue triangles to indicate uncertainty regarding the start or endpoint of a task. Risky Project also allows the user to see the risks/opportunities that have been associated with a specific task during the implementation of the risk register utilizing arrows indicating them.
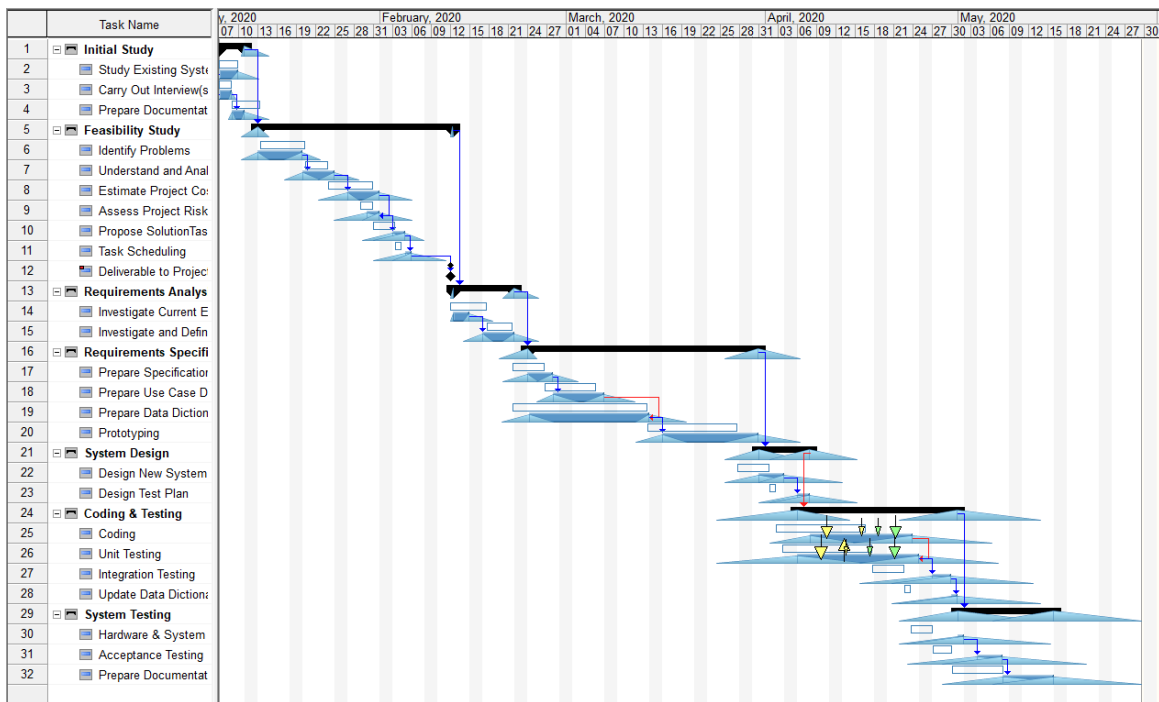

Figure 23 – Gantt with variability

4.2.2.3   Cost analysis

Risky Project also graphically represents costs against time so that the user can see how the Actual Cost of the real project, represented by a green line, deviates from

the Planned Value established during the planning phase and from the Earned Value. The Actual Cost curve is based on the actual amount of work spent for each resource in each project activity entered by the user, while the relative Earned Value is automatically calculated based on the same values. With the cost chart, it is possible to see if there are delays or savings in the activities or if the activities require more or less cost than budgeted.
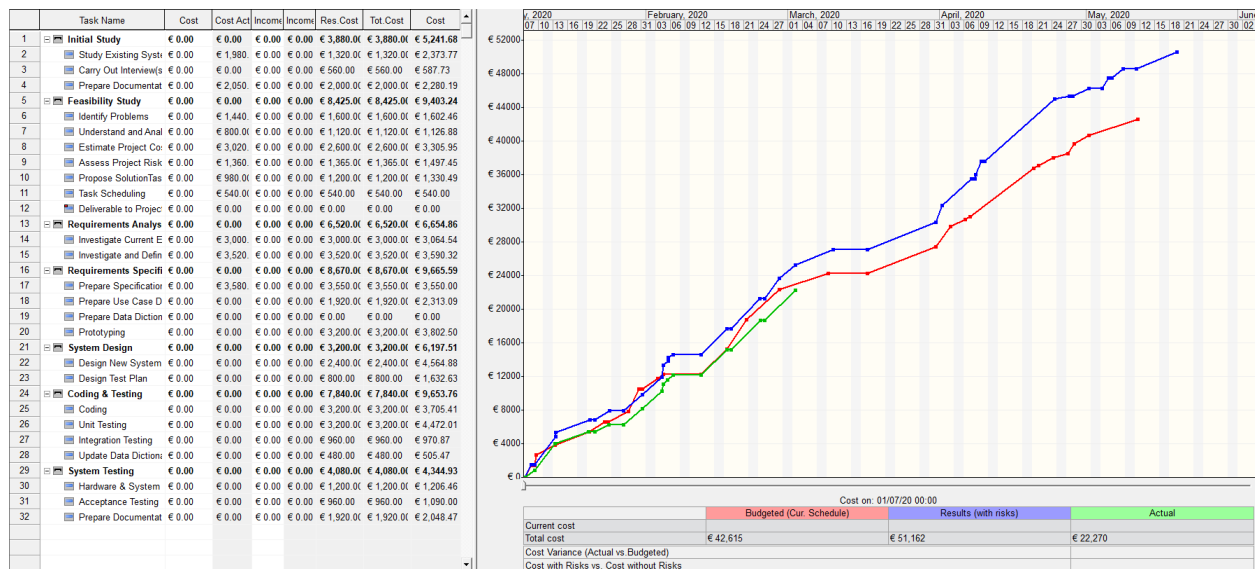

Figure 24 – Cost analysis

4.2.2.4   Cashflow analysis

In addition to the cost analysis, the cash flow analysis is also shown monthly to display how cash flows can change due to project risks. Similar to the previous analysis, Risky Project allows visualizing the trend of the cash flow values as in *figure 25*. Specifically, worst, best case, and baseline values are shown in blue, light blue, and purple, respectively, planned values as a red line and actual values in green.
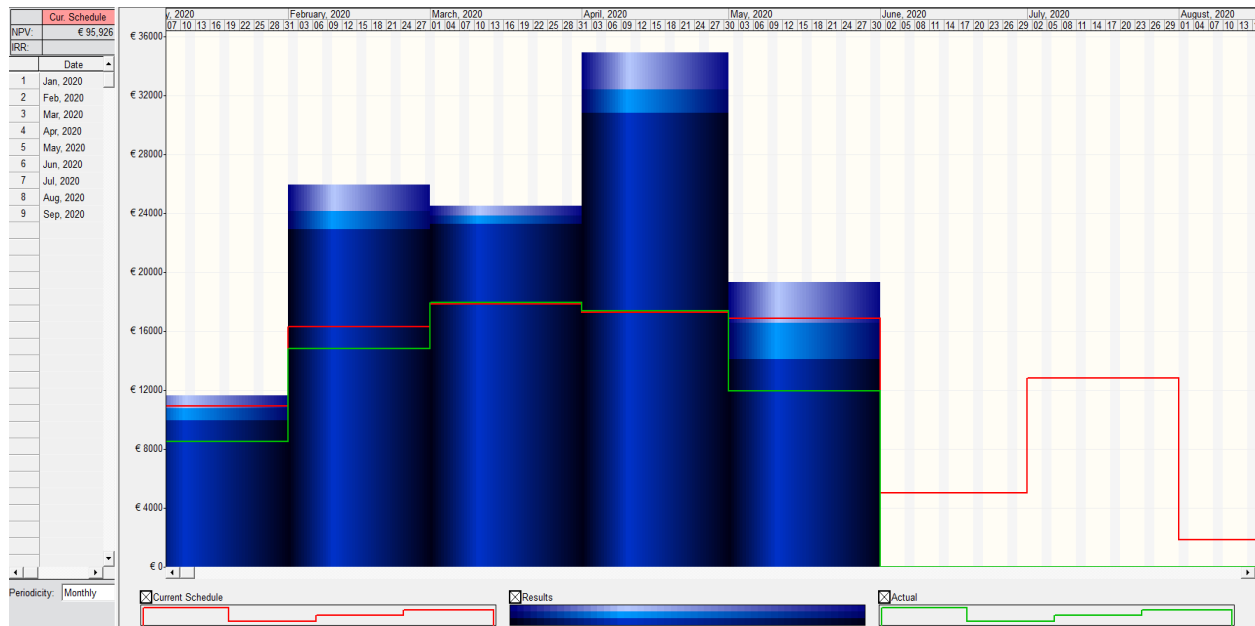
Figure 25 – Histograms of cashflows

4.2.2.5   Sensitivity analysis

Risky Project allows performing a sensitivity analysis to study the sensitivity of the project objectives concerning the input parameters. It shows how much each input parameter can affect the project objectives. To measure this sensitivity, Risky Project resort to the Spearman correlation index that measures how much the change in the value of an input parameter, due to project risk, will affect the change of the output selected from the user. The greater this factor is, the greater the potential that the parameter under consideration has.

To measure it, Risky Project uses six parameters:

- Task duration,
- Task start time,
- Task cost,

- Task success rate,

- Lags,

- Risks.

Moreover, it has the following output parameters:

- Duration,

- Finish time,

- Cost,

- Success rate.

	Name	Task ID	Type	Risk Assigned To	Sensitivity Chart	Cost (Pre-Mi	Ranking	Note
1	Risk: HACKING		Risk	All tasks (global)		€ 3,111.75	1.000	
2	Risk: OBJECTIVE DEFINITION		Risk	Assigned to 2 tasks/resources		€ 2,587.18	0.788	
3	Risk: EMPLOYEE HEALTH		Risk	All tasks (global)		€ 1,303.04	0.405	
4	Risk: POTENTIAL LAWSUITS		Risk	All tasks (global)		€ 957.04	0.304	
5	Risk: OBJECTIVE CHANGES		Risk	Assigned to 2 tasks/resources		€ 0.00	0.189	

Figure 26 – Sensitivity analysis

4.2.2.6   Risk Chart

Once finished with the simulation, the software shows the impact of risks on tasks concerning their duration and cost. In the risk chart, the bubbles represent the tasks while, as regard *figure 27*, their diameter represents the total cost. The total cost can be shown in various ways:

- Standard deviation,

- Minimum or maximum values,

- Range,

- Percentiles.

The purpose of the risk chart is to allow the user to identify which risks should be subject to mitigation and which should be accepted by considering their duration, cost, and associated risks.
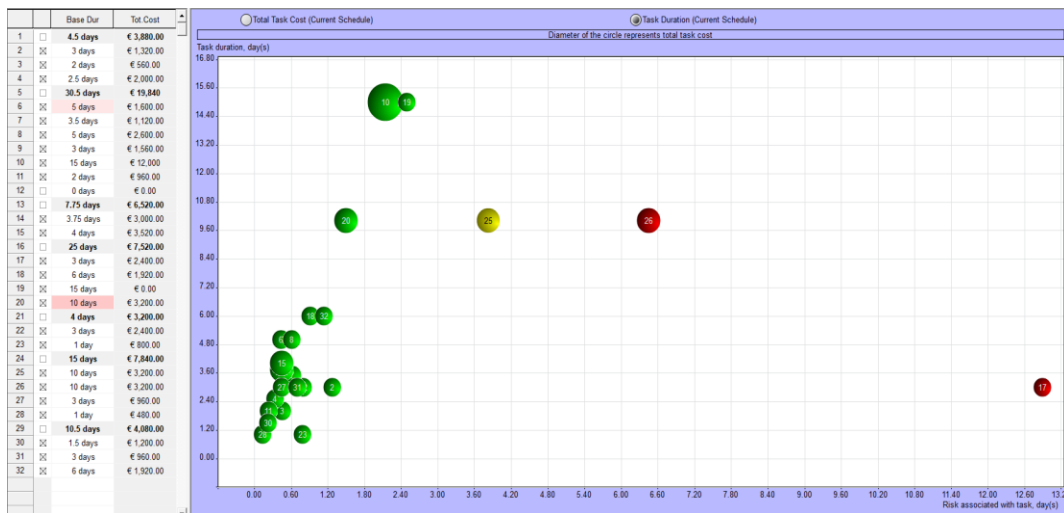

Figure 27 – Bubble chart

4.2.2.7   Success rate chart

The quantitative analysis provides a success rate Gantt, in which the tasks are colored differently to represent the range of success rates, and the risks are represented by arrows indicating the task.
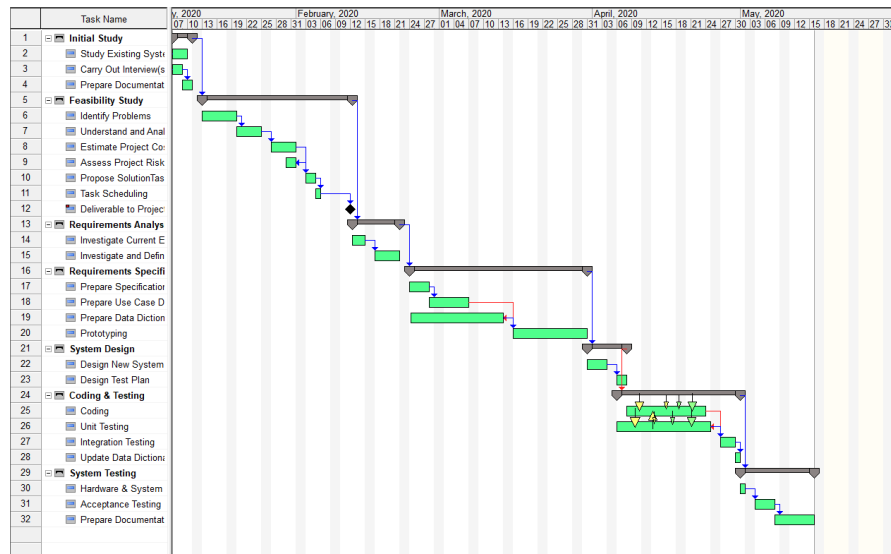
Figure 28 – Success rate chart

4.2.2.8   Crucial tasks

Critical activities are on the critical path and can be identified by performing a critical path analysis on a deterministic schedule. Unlike these, the critical activities computed from Monte Carlo simulations consider the random nature of the activities to analyze the possibility that in real-life situations, multiple possible critical paths may occur depending on what occurs during project execution. RiskyProject does not perform critical path analysis; it, instead, identifies crucial tasks that provide insight into which activities have the most probabilistic potential to impact the schedule.

So during each iteration of the Monte Carlo simulation, the software monitors how changes in the duration, start or finish time of the task impact the project schedule. To understand how this happens, Risky Project calculates the correlation between task variance and project variance in terms of duration and cost and shows it as in the following Gantt in *figure 29*.
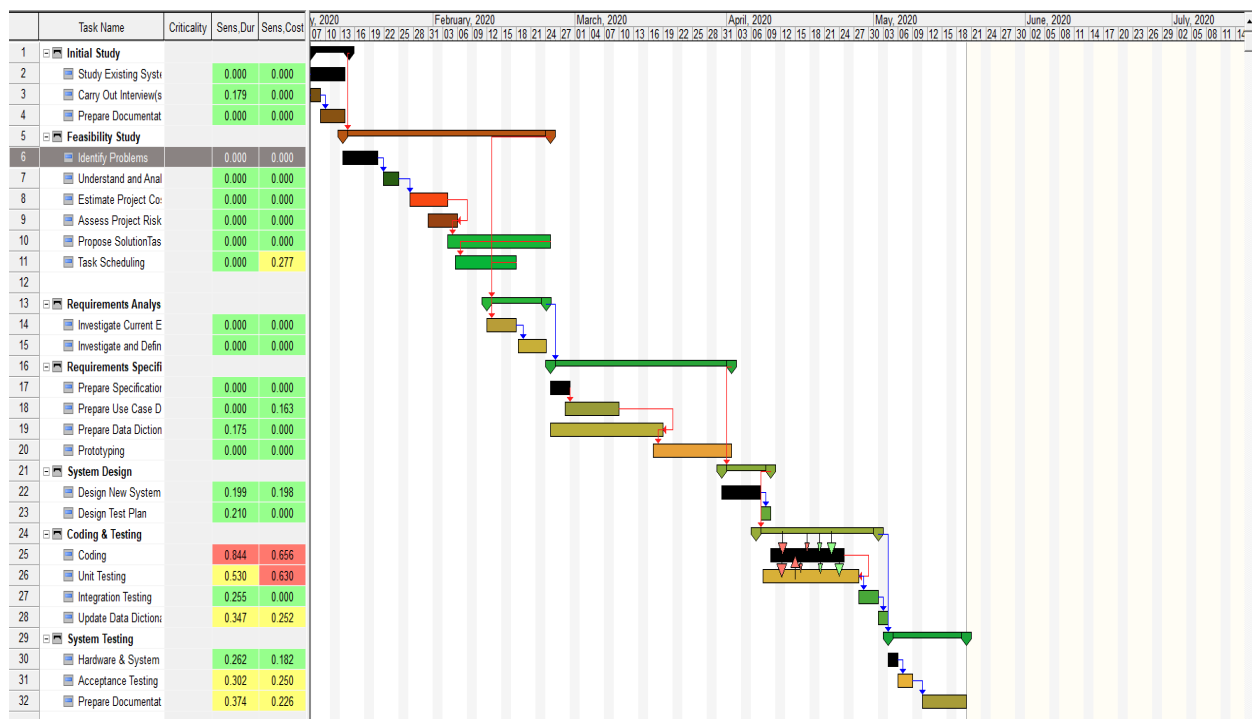

Figure 29 – Crucial task Gantt

Chapter 5 - Monte Carlo remarks [6]

5.1 The Project Risk Management

Since the Monte Carlo method is a Project Management methodology, it is worth discussing and expanding on this subject by covering risk management according to **Project Risk Management** processes.

Project Risk Management is a crucial Project Management practice that aims to predict uncertainties and minimize their occurrence or impact through an ongoing risk management process that helps project managers to identify, understand, and respond to threats and opportunities. The field of research regarding which processes belong to **Project Risk Management** is still open (the steps and processes vary depending on the level of detail to be achieved), but the basic processes for conducting a proper **Project Risk Management** process are as follows:

- Risk Identification: which is the identification of risks or their sources;
- Risk Evaluation: evaluate risk in terms of probability and impact in order to establish a priority order among the identified risks;
- Risk Handling: the process that identifies, evaluates, selects, and implements different options to obtain an acceptable risk threshold while respecting project constraints and objectives. In particular, it includes what needs to be done, when, who is responsible for it, and the associated cost and schedule;
- Risk Controlling: the continuous reporting and monitoring of both risks and their management mechanisms. Reporting, in particular, has the function of improving communication within the project, and in the long term, creates historical precedents that can be used to obtain in future projects a more

accurate prediction of risks that have already been addressed in similar projects.
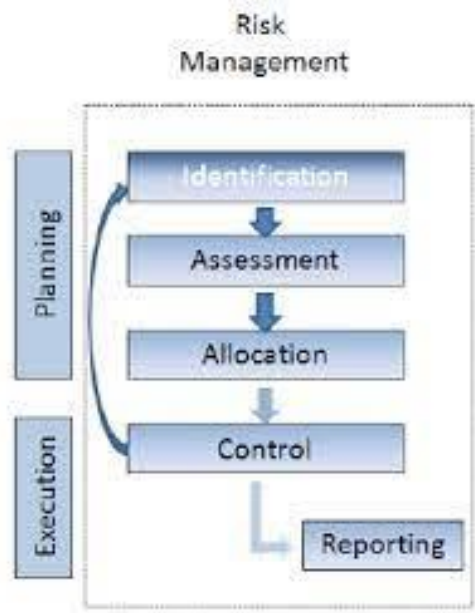
Figure 30 – Project Risk Management process

The **Project Risk Management** (PRM) system relies on employees' skills willing to use it to achieve project goals, and before putting it into practice, managers have to understand the organization's practices and how to conduct risk work for that project. The primary input to the four reported processes is the **Risk Management Plan**, which describes how the project's risk management is structured and executed.

5.2 Monte Carlo method and PRM

From what has been observed in the previous chapter, it is, therefore, possible to state that the Monte Carlo method is a risk management technique used in Project Management whose purpose is to determine the impact of project risks and establish a range of possible outcomes with their respective probabilities of occurrence. Having clarified the method and procedure by which it reaches the final project results, it is now worth investigating the effectiveness of its application when **Project Risk Management** processes (that are the basis of risk management in Project Management), are adopted for risk evaluation. In this case, in fact, the Monte Carlo analysis results are not accurate. The reason for this is the lack of a methodological approach to risk management within Project Management. The data entered as input to the Risky Project are, in fact, the result of a subjective assessment made by experts (such as project risk managers) or derived from statistics related to the type of initiative under consideration. For this reason, it is possible to say that there is no objective basis to explain the use of such data. Both experts with long experience in project risk management and data collected from statistics on similar projects have no relation to the specific risk determinants of the project under analysis. It is precisely for this reason that today there is an increasing need to adopt Risk Management processes instead of **Project Risk Management** processes to manage project risks. Therefore, the problem in itself does not lie in using the Monte Carlo method as a Project Management technique but in the context in which it is used. Therefore, it may be worthwhile to decouple the Monte Carlo technique from **Project Risk Management** processes and apply it in a Risk Management scenario, such as in the case of Project Rating methodology application. Therefore, later on (chapter 8), we will propose the integration of the

Project Rating methodology to the Monte Carlo method in such a way as to try to achieve greater precision of the results.

Chapter 6 – Risk Management as a means to facilitate the activation of the Recovery Plan [8]

6.1 Introduction

This chapter will deal with the technical-procedural aspects related to the activation and realization of projects, proposing the Project Rating as a tool to facilitate the activation and use of the Recovery Fund (NRRP).

6.2 The Recovery Fund

The Recovery Fund is a term that has been declined in several definitions and acronyms, Recovery Plan, NGEU (New Generation Europe), NRRP (National Recovery and Resilience Plan), so that the ordinary citizen is not always able to understand what the different terms used mean. However, it has a clear purpose, easily understood by anyone:

"with the Recovery Fund, the European Community provides European nations with substantial funds with which projects capable of overcoming the economic crisis generated by the covid-19 pandemic must be carried out."

This idea quickly became the common will of all European countries, thus demonstrating the importance and usefulness of the European institution for the populations of individual states. The **Recovery Fund** proved to be a unique opportunity that the pandemic brought, transforming the economic crises it brought into opportunities to start healthier economies. Suffice it to say that today, the availability of a great deal of financial liquidity enables countries to carry out numerous projects, transforming ideas into reality and pursuing the common good instead of the interests of the few, sources of social inequality. Therefore, societies are progressing and modernizing with the Recovery Fund, pursuing new and better economic and social development models. Since such funds provide enormous opportunities for recovery, expectations are very high and difficult to maintain. Nonetheless, the **NRRP** has its positive side, given that the most significant challenges are usually those that most distinguish the progress of societies.

Therefore, within this scenario, there is only one way forward, which requires the best use of European funds to benefit healthy and fair economic growth. Therefore, it is up to the ruling public administration classes, which have been assigned to indicate and choose the best strategies and solutions to make the most of this opportunity. Moving from ideas to concrete facts is not a simple matter. Indeed, it is precisely in this transition that difficulties arise and grow, for which solutions must be sought that have the ultimate goal of overcoming the crisis.

6.3 The Project Rating as an instrument of economic recovery

As it is well known, **Recovery Fund** is composed of a list of projects to be submitted for funding, which, due to the number and complexity of interventions, generates a series of "issues" in terms of activation modalities of each project, so much so that, if not solved, they may jeopardize the availability of funding granted in the first instance by the European community. Many issues create "problems" that must be the subject of attention and care by competent bodies. Among these, two are the main ones:

1. the quality of the projects for which funding is requested,
2. the actual ability to finance the project.

On these two points, **Project Rating** as a Risk Management methodology focused on resolving these issues can provide solutions to overcome them.

6.3.1 The first step: authorization to finance the individual project

First of all, it must be said that the activation of the **Recovery Fund** requires compliance with a precise authorization process that starts with the presentation of individual projects and is articulated in the subsequent phases, in all those technical and procedural aspects that have the duty of verifying the consistency of the individual interventions with the objectives envisaged and described in the Recovery Plan (NRRP), up to the "approval" of funding. The type of "approval" of financing by the European authorizing bodies is a matter of great debate and even interpretation by some. The fact is that without this, the funding is not granted, and the project does not start.

Therefore, it will be necessary to follow, in a form at least agreed upon between the parties, the authorization process indicated above, whose **first step**, which is also the priority and most challenging activity, consists in presenting the project to be financed only after having carried out accurate programming and planning of the interventions, (activities of exclusive competence of the state offices). The technical and planning methods that will be adopted in this phase, also defined as pre-feasibility of the work, will not always be able to foresee an accurate study of the planning components, given the complexity of the interventions and the urgency of receiving the first funds; therefore many of the projects included in the Recovery Fund (PRRP) will be identified by adopting the principle of priority of intervention assessed on a political-social basis. Proceeding in this way, however, it is clear that the verification of the real compatibility of the individual project to the specifications and objectives agreed with the European control authorities can be carried out only after the approval of funding, and this will lead to many problems of adjustment and correction of multidisciplinary content. The main problem is that, if not carried out in a shared form and in a short time, these activities can put in difficulty the regular start of the financing process imposed by the EU. In addition, correcting the EU funding authorization post-authorization involves further difficulties. The main one concerns "project inhomogeneity," understood as old and new funded projects with different prevailing impacts. It is, in fact, probable that the old projects contain, as prevailing criticality, aspects of a bureaucratic-administrative nature that delay their realization in time, while the new projects seem to have as main criticality the absence of verification of the

territorial-environmental and social impact, due to the speed of the proposal that does not allow to carry out the complete and correct verifications.

However, all these difficulties are nothing more than **criticalities** that, if not managed correctly and promptly generate **risks** understood in their negative sense. What comes out of it is the necessity to adopt instruments capable of foreseeing and managing the evolution of **criticalities** into **risks**. In this regard, the methodologies of Risk Management (including Project Rating) adopted in managing risk within the various project phases are proposed as the best tools to best address these relationships.

6.3.2   The third step: realization

The **third step** concerns the realization of the work, which involves monitoring the progress of the worksite through which it must proceed to precise and accurate control of the two parameters that measure the real success of a project, and precisely the respect of **costs** and that of **times**. It goes without saying that if these two parameters are not respected, then the tranches of financing to SAL of the work could be jeopardized by Europe, thus generating evident financial criticality due to the high volumes of money in circulation, so much to generate a negative impact on the state budget. Therefore, the ability to provide valid and timely updates on the status of the two parameters, costs and times, turns out to be a significant control activity for the disbursement of financing. However, precisely because both are the result of an articulated management process during the project implementation phase, it will not be easy to consistently meet expectations, given the large number of projects that will be undertaken and,

above all, their complexity. Setting up a correct and effective cost and time control process means entering into **risk analysis** by adopting a mitigation strategy that strongly impacts the conduct and management of the project. After all, it is no longer thinkable to realize works in large numbers and with highly innovative technological content using only the classic tools of Project Management without adopting Risk Management as the focus of the site's forecast. All this involves a change of mentality not only by technicians but also (and especially) by those who must relate with the European control bodies responsible for the provision of funding granted.

6.3.3 The fourth step: restitution

The **fourth step** envisages the repayment of a large part of the financing provided by the **Recovery Fund** on rather advantageous terms for the users. This repayment being an obligation must be possible without creating further social debt. In other words, for it to be realized, it will be necessary to draw on the surplus of GDP produced thanks to the virtuous process triggered by the **Recovery Fund** through the financing of good projects. Thus, from this need, it is possible to highlight the importance of focusing on projects quality to ensure the achievement of the objectives set by the **NRRP**.

In this regard, to ensure the achievement of quality projects, it will undoubtedly be necessary to:

- Combine widespread skills with tools and methods of project management and planning.

- Introducing the **project risks analysis** to support the work's planning and execution activities.

To this end, since Risk Management adopts risk analysis as the basic principle for evaluating the project's content, it makes it possible to forecast compliance with the repayment of the financing obtained. Considering, at this purpose, that the objective is to think and make **good projects**, it will be undoubtedly necessary to eliminate the fragility that each project brings as a generator of **criticalities** and **risks** arising from the interdisciplinary nature of the project components. So, in this regard, Risk Management methodologies as valuable tools to identify, analyze, and manage **criticalities** and project **risks** are the safety guarantee for the **Recovery Fund.**

Chapter 7 - Cultural change [III] [IV]

What was discussed in the previous chapter makes one think about the importance of using tools such as Project Rating to ensure the achievement of the goals listed in the **National Recovery and Resilience Plan** (NRP) guidelines. Nonetheless, their use should be discussed more broadly, taking into consideration the implications of their use. Moving, in fact, from a common risk management logic such as the one adopted in Project Management, in which project risk management is referred to as an "of which," to a Risk Management logic, in which project risk management is looked at as a separate discipline, requires a cultural change. The adoption of a

new paradigm capable of dealing with the conditions posed by the post-pandemic will therefore require a change of mentality not only on the part of the technicians involved in the implementation of the risk management strategy but also on the part of the bodies responsible for liaising with the European control bodies. Specifically, the benefits expected from the introduction of an innovative risk management culture will be those arising from the application of **ISO 31000**, in particular:

- increasing the likelihood of achieving goals: understood as reducing the likelihood of an adverse event occurring;
- encouraging proactive management;
- improve cogent and voluntary reporting;
- build a reliable basis for decision-making and planning;
- increase performance in health and safety - environmental protection;
- improve organizational learning.

In embracing this change, adopting **ISO 31000** (chapter 1.3) is helpful as a guideline that provides an operational standard. Although its usefulness, however, its use may therefore prove to be of no easy use. Indeed, its generality entails a difficulty of practical application left to the individual subjects in charge of risk management, which require (particularly in the field of construction and public infrastructure) precision and clarity. Adopting an operational standard like the one proposed by **ISO 31000** moreover, besides requiring integration of rules and regulations that are at the basis of the activity of technicians and experts, requires the use of a project management model that excludes the use of procedural standards.

Therefore, these are the criticalities that limit the adoption of **ISO 31000**, making it challenging to apply risk management and leading the subjects to prefer normative actions consisting of the issuance of precise rules and procedures that do not give rise to interpretations.

Chapter 8 - Integration of Project Rating and Monte Carlo method

Once Project Rating methodology and Monte Carlo method have been analyzed, it could be interesting to study how to integrate them to achieve better accuracy in predicting project outcomes (as previously mentioned in chapter 5.2). The Monte Carlo method, in fact, despite being one of the most talked-about project management techniques in academic circles, does not find much application in project implementation. For this reason, given its potential, it might be worth discussing its possible application in the case of Risk Management methodologies adoption to risk management. Then, the possible issues generated during the integration and the characteristics of the model under analysis will be reported below.

To achieve an integrated model of the two methodologies, it will be initially necessary to think if the outcomes resulting from Project Rating are or are not employable as input of the Monte Carlo simulation. In order to answer this question, reference will be made to the case discussed in chapter 2 concerning the redevelopment and redesign of some buildings within the municipality of Milan. In

doing so, comparing the data, it is possible to notice the first problem immediately. If indeed, one was to use as input the data in *figure 31* (in which the results and the planning of the risks deriving from the Project Rating are reported) and decided to insert them in Risky Project, he would immediately realize that there is no compatibility with the data requested as input by the software. The reason for this is the different perspectives of the two approaches. It is, in fact, observable that Project Rating subdivides the project into project phases while the Monte Carlo simulation, being commonly used in Project Management, is usual to demand in input a detail of the project activities and a repartition of the employed resources.

Code	Cause	Risk and Effect	Level	Mitigation Target		Document Name	Card
R_2.13	Absence or lack of information of project costs	Unreliable cost analysis	High	90%	100%	P0_M1_A1_1.1_75 Cost and benefit analysis	Card 1
R_2.41	Absence or lack of information of project rev	Unreliable revenue analysis	High	90%	100%	P0_M1_A1_1.1_75 Cost and benefit analysis	Card 2
R_2.14	Absence or lack of information of benefits.	Unreliable benefit analysis.	Critical	90%	100%	P0_M1_A1_1.1_75 Cost and benefit analysis	Card 3
R_2.15	Risk of unverified economic feasibility.	Difficulty in decision-making with regard to the realization of the work	Critical	90%	100%	P0_M1_A1_1.1_75 Cost and benefit analysis	Card 4
R_2.5	Insufficient expense coverage.	Impossibility of carrying out the intervention in its entirety.	High	90%	100%	P0_M1_A1_1.1_75 Cost and benefit analysis	Card 5
R_2.18	Risk tempo_Assenza of planning activities.	Difficulty in the correct planning of the procedural process.	High	75%	100%	P0_M1_A2_1.1_76 Geneticity of the project	Card 6
R_2.4	Absence of design alternatives.	Absence of comparative solutions for the assessment of the quality of the design choice adopted.	Moderate	90%	100%	P0_M1_A2_1.1_76 Geneticity of the project	Card 7
R_2.2	Assets in a very bad state of repair	Possible extension of time and increased costs for the safety and future use of the Asset.	Low	100%	100%	P0_M1_A1_2.1_77 Technical and territorial aspects	Card 8
R_2.42	Old and/or in ascertainable plants	Perform extraordinary maintenance work and / or rebuilding of the plants, increase costs	Moderate	100%	100%	P0_M1_A1_2.1_77 Technical and territorial aspects	Card 9
R_2.6.0	Environmental risk.	Impossibility to define with certainty the presence of critical issues in environmental matters.	High	50%	100%	P0_M1_A1_2.1_77 Technical and territorial aspects	Card 10
R_2.37	Lack or lack of information related to the Urban Reference Tool	Possible incompatibility of any design changes with urban planning regulations	Low	90%	100%	P0_M1_A1_2.1_77 Technical and territorial aspects	Card 11
R_2.38	Lack or lack of information related to the land registry.	Possible occurrence of cadastral discrepancies subject to possible sanatorium.	Moderate	90%	100%	P0_M1_A1_2.1_77 Technical and territorial aspects	Card 12
R_2.19	Risk tempo_Assenza of planning	Difficulty managing any unexpected events at run time.	High	90%	100%	P0_M1_A1_2.1_77 Technical and territorial aspects	Card 13
R_2.22	EE.PP. List of non-exhaustive interest.	Lack of all the necessary authorizations for the start of the work.	Moderate	90%	100%	P0_M1_A1_3.1_78 Legal aspects	Card 14
R_2.5	Absence or incomplete reference list of regulatory constraints.	Design choices without support regulations (volontatia/cogente).	Moderate	90%	100%	P0_M1_A1_3.1_78 Legal aspects	Card 15
R_2.39	Lack of documentation relating to municipal authorizations and presence of formal irregularities.	Unverised building regularity and fines and penalties for ams sanatoriums.	Low	100%	100%	P0_M1_A1_3.1_78 Legal aspects	Card 16
R_2.40	Presence of constraints or charges to be borne by the promoter	Extended time and increased costs.	Low	100%	100%	P0_M1_A1_3.1_78 Legal aspects	Card 17
R_2.21	Strategia_Criticità risk from sensitivity analysis	Difficulty in identifying the solution strategies.	High	90%	100%	P0_M1_A2_4.1_79 Sensitivity analysis	Card 18

Figure 31 — Critical planning

It seems, therefore, a critical issue. In order for it to be overcome, if the experts involved in the risk analysis are unable to determine on which of the different project activities the various criticalities impact, they can assign the risk to the entire project phase by selecting one by one the activities that make it up within the risk register. In this regard, it should be remembered that Risky Project allows the assignment of risks to more than one project activity (*figure 19*).

However, If this criticality seems in a certain sense surmountable, there is a second one that arises as a more significant obstacle when trying to integrate the two methodologies. Once the schedule has been programmed in the way described, indeed, remains the issue of interpreting the risk values to insert in the risk register (*figures 18* and *19*). Since the present data in *figure 31* are values of qualitative type and there is no **qualitative risk ranking** (*figure 32*) unique and universal, it will be somewhat complex to translate them coherently in values percentages to insert inside the software.

Rank	Prob.	Impact on project objectives			
		Cost	Time	Scope	Quality
VHI	70-99%	>40% cost increase	>20% time increase	Project end item is effectively useless	Project end item is effectively useless
HI	50-70%	20-40% cost increase	10-20% time increase	Scope reduction unacceptable to sponsor	Quality reduction unacceptable to sponsor
MED	30-50%	10-20% cost increase	5-10% time increase	Major area of scope affected	Quality reduction requires sponsor approval
LO	10-30%	<10% cost increase	<5% time increase	Minor areas of scope affected	Only very demanding applications are affected
VLO	1 -10%	Insignificant cost increase	Insignificant time increase	Scope decrease barely noticeable	Quality degradation barely noticeable

Figure 32 - Qualitative risk ranking

Replacing the use of an expert assessment with many years of experience in risk management and statistical data with results from Project Rating will require, therefore, the creation (for every Project Rating model and type of initiative) of a standard **qualitative risk ranking** to be used for the transformation of qualitative data into well-defined quantitative percentage data. The data to be included in it would be better not to be derived from expert judgment; penalty, the level of objectivity of the entire analysis would deteriorate. In this regard, it would be appropriate for these values to be estimated using quantitative mathematical and statistical methods, even if this should require a great deal of time and computing power.

The following example reports a Monte Carlo simulation executed through the software Risky Project using the data reported in *figure 31* and *figure 32*.
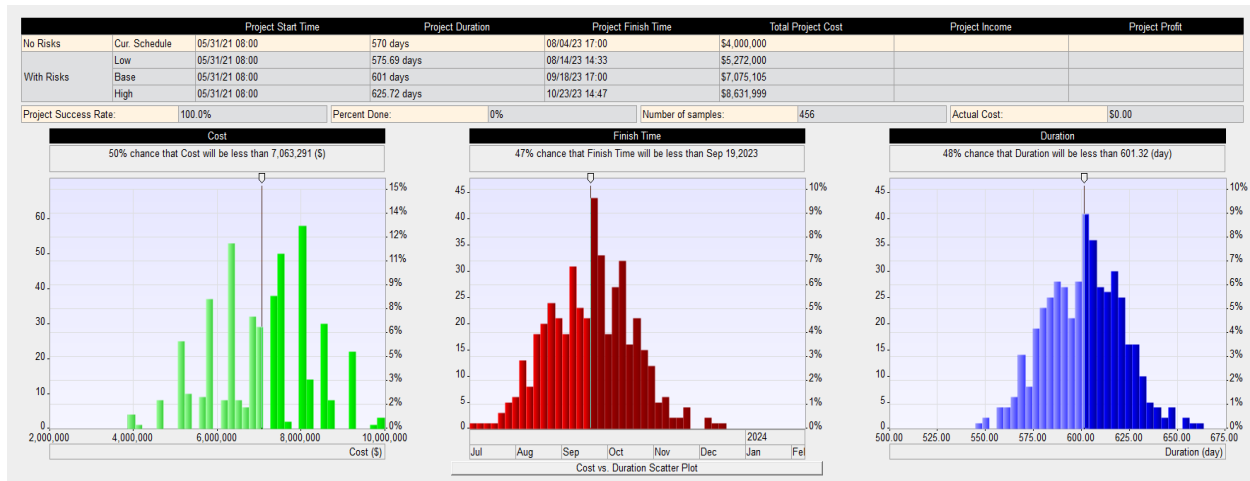
Figure 33 - Histograms of integrated analysis

As shown from the results, the outcomes obtained from the analysis differ significantly from the values observed in *figure 14*. All this happened because the analysis used a **qualitative risk ranking** inappropriate for the adopted rating model. This example, therefore, underlines the need to define a system capable of obviating the simplification.

Secondly, net of the issues encountered, it should also be pointed out that, since the Project Rating aims to manage the risks that characterize the various project phases, the values it provides will be used solely as input for the risk register. While, as far as identifying the project estimates and probability distributions to be inserted in the project schedule is concerned, the information to be inserted will still be derived from the evaluations of the project team. Therefore, the subjectivity of the analysis will only be partially eliminated, given that the Project Rating methodology does not provide specific estimates for individual project activities.

Chapter 9 – A project management platform for the integrated model [7]

9.1 Introduction

The decision to integrate a Risk Management methodology within a Project Management technique was taken to reach a possible approach to project

management. Therefore, If such integration were realizable, it would be convenient to create a new platform for project management through the new model. In this way, it would be possible to organize in a structured and straightforward way for each project phase and for the different commissioned projects: the project files, the data elaborated in the implementation of the Project Rating and the input and output data used to carry out the Monte Carlo simulations. As a starting point, one needs to ask what platforms are commonly used to perform risk analysis with Project Rating methodology, considering that Project Rating is an integral part of the model. Looking at the various project risk management platforms used by entities employing this methodology, it can be seen that the most commonly adopted structure is the one adopted by **Web Risk Platform** (WRP). For this reason, in the next paragraph, this platform will be taken as a point of reference to analyze its characteristics to establish a starting point for the realization of a management platform for the entire model.

9.2   Web Risk Platform

The first window that a risk management section of the platform should have (as in the WRP case) is the **dashboard** (*figure 34*). It should define the assets and the projects associated with them.
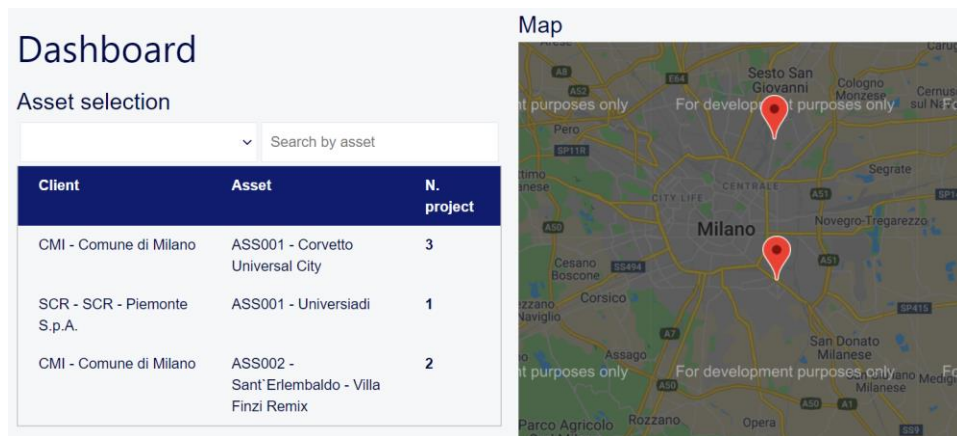
Figure 34 – Dashboard (1)

In addition to the analysis results, it is also necessary to report detailed information such as the progress status and the project phase (*figure 35*) for each project that makes up the asset.
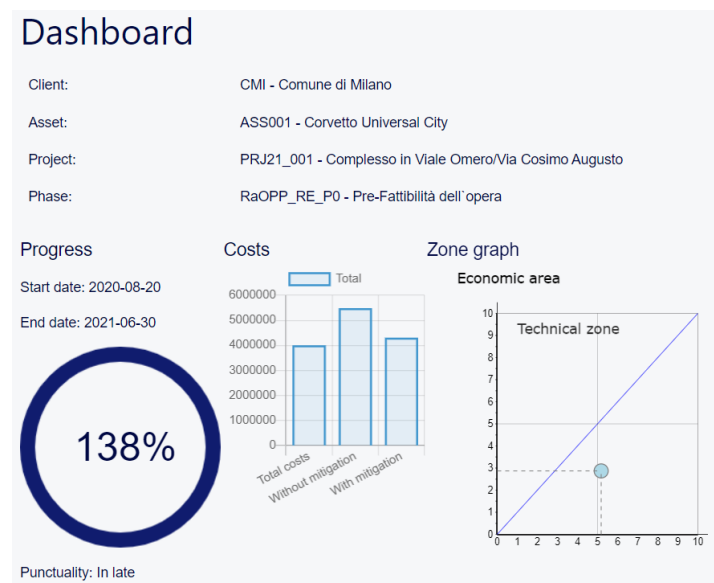

Figure 35 – Dashboard (2)

A second interface essential to the platform is the **register of users and personnel**. It should aim to clearly define the different actors involved in using the platform and the roles associated with them. An example of a system user registry is shown in *figure 36*.

Figure 36 – User list

In addition, it will be necessary to introduce a window aimed at managing the project files. At the beginning of risk analysis, it is, in fact, necessary to upload the project files and the WBS documents for each of the reference initiatives in order to have a documental base to refer to during the whole project risk assessment process. For this reason, the "documents" section must have a structure similar to the one shown in *figure 37*.

Figure 37 – Project selection

By clicking on each project, the completed WBS documents will have to appear, and for each of them, the Unique Archive documents from which the information have been obtained (*figures 38 and 39*).
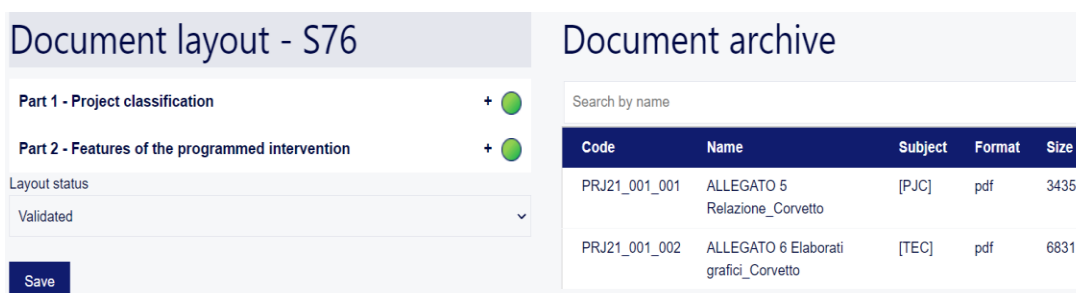

Figure 38 – Document selection

Figure 39 – Document layout

Once the information has been organized within the layouts present in the WBS Documents, it will be necessary, as foreseen by the Project Rating methodology, to identify for each of them the criticalities and risks they contain in such a way as to be able to carry out the qualitative and risk analyses (described in chapter 2.1.4) required for progress in the evaluation procedure. Therefore, it will be necessary to create a dedicated interface to manage the criticality-risk relationships and the

disposition of the data resulting from the evaluations carried out by the experts of the various technical areas of the project. So, the window in question called "scoring and outcomes" must have a section for each layout like the one shown in the figure.

Figure 40 - Qualitative and Risk analysis

Once the qualitative and risk analyses have been completed, the technicians in charge of the risk assessment will have to calculate the Driver In and Driver Out values for each reference initiative starting from the values assigned in the previous analyses. It will, therefore, be necessary to create a window dedicated to the arrangement of the data obtained from the use of the CAC model. Then, for every

WBS document belonging to the Driver In and the Driver Out, it will be necessary to predispose a table containing all the information as in the figure below.

RaOPP_RE_P0_DI_02 - Aspetti tecnici del progetto

Document	Document type	Value	Obligatory	Value	Version	Value	Relevance	Value	Score	%
RaOPP_RE_P0_M1_A2_1.1_76 - Generalità del progetto	B - Self-certification	1	Yes	1	Base	0	Essential	5	7	25
RaOPP_RE_P0_M1_A2_2.1_77 - Aspetti tecnici e territoriali	C - Official	3	Yes	1	Base	0	Very relevant	4	8	29
RaOPP_RE_P0_M1_A2_3.1_78 - Aspetti legali	C - Official	3	Yes	1	Base	0	Very relevant	4	8	29
RaOPP_RE_P0_M1_A2_4.1_79 - Analisi SWOT	B - Self-certification	1	No	0	Base	0	Very relevant	4	5	18
								TOTAL	**28**	**100**

Figure 41 - Driver In computation

Driver out selection

Contesto sociale

Code

RaOPP_RE_P0_DO_01

Description

Contesto sociale

Driver out valuation

Min value	Max value	Mean value
1	-2	-0,50

Driver out relevance

Relevance	Value
Essential	5

Figure 42 - Driver Out computation

Finally, as the last section aimed at applying the Project Rating method, the platform provides a window showing the Critical Summary obtained from the project risk assessment and mitigation phases (see chapter 2.1.4). It will have a structure like the one shown in the figure.

| Risk code	Risk level	Mitigation action	Risk priority	Mitigation starting day	Mitigation ending day	Mitigation duration [days]
R_01_01.75.1.1	High	Predisporre un QTE, con un CME con quantità approssimate ma derivanti da schemi e/o elaborati progettuali ad una scala non inferiore a 1:1.000 e con prezzi unitari di tipo stima ottenuti applicando l`EP del Comune di Milano o similari.	High	70	100	30
R_01_02.75.2.1	High	Valutare i ricavi in relazione ai canoni di locazioni in essere e quelli nuovamente calcolabili a seguito dell`avvenuto intervento.	High	80	110	30
R_01_03.75.3.1	Critical	Eseguire accertamenti e verifiche in merito ai benefici.	High	80	110	30
R_01_04.75.4.1	Critical	Effettuare il calcolo del VANE, TIRE e RBC applicando le formule riportate nelle schede del modello ed utilizzando i valori di costo e ricavo (benefici).	Medium high	100	130	30
R_02_03.75.5.1	High	In base alle risultanze della determinazione dei costi accertare l`effettiva totale copertura della spesa ed in caso negativo, prevedere ulteriori forme di copertura di spesa, esplicitando importo e, tempi e modalità di attivazione.	Medium high	100	240	140
R_03_02.76.1.1	High	Eseguire un cronoprogramma dettagliato.	Low	0	0	0
R_03_01.7621	Moderate	Predisporre delle idonee alternative progettuali.		0	0	0
R_04_01.77.1.1	Low	Indicare con l`uso di elaborati grafici, schemi e similari, gli interventi da realizzare con un adeguato dettaglio tecnico/progettuale. effettuare un rilevamento dello stato manutentivo dell`immobile e degli impianti.	High	30	90	60

Figure 43 - Critical Summary
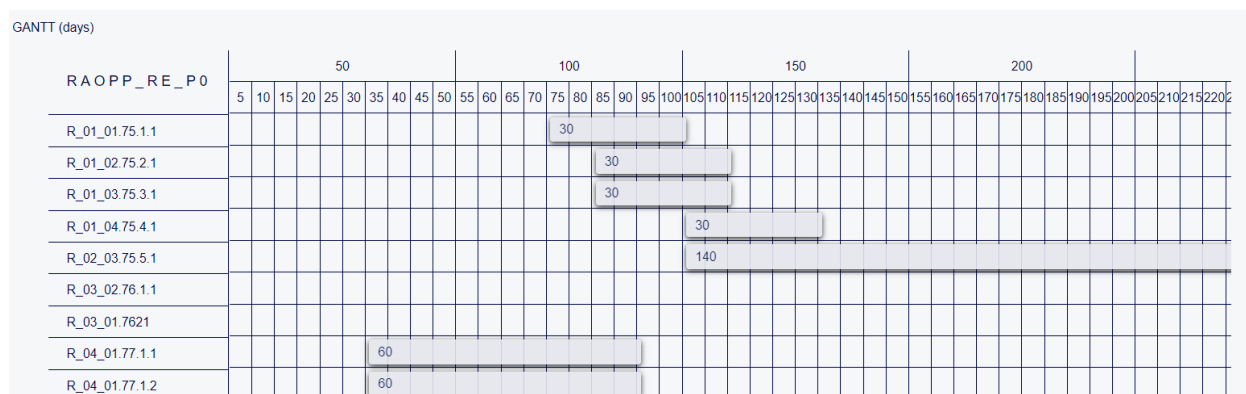
Figure 44 - Mitigation Gantt

9.3 Platform implementation

Once the analysis of risk is concluded through Project Rating methodology, as previewed from the model discussed in the previous chapter, the Monte Carlo simulations will have to be carried out to determine the impact of the identified risks and identify a range of results. For this, it will be necessary to add to the platform an ulterior section aimed at project management, within which, for each

intervention, the data obtained from the simulations carried out will be organized. Depending on the sophistication of the platform to be achieved, additional sections can be added aimed at budget management, collaboration, communication, decision making, and administration.

Chapter 10 – Conclusions [8]

From what has been said in the previous chapters it is, therefore, possible to summarize that:

1. If one wants to successfully deal with the issues present within the different project phases and arising after the allocation of the **NRRP**, it will be necessary to adopt tools able to: highlight project **criticalities**, eliminate the fragilities deriving from the interdisciplinary nature of project components, foresee and manage the evolution of **criticalities** in **risk** and adopt a correct mitigation strategy.

2. To carry out all these activities to deliver quality projects, it will be necessary to use methodologies that allow the execution of (mostly) objective evaluations and thus apply methodological approaches to project risk management that are typical of Risk Management.

3. The Monte Carlo method, as a risk management technique used in Project Management, does not provide accurate results when it adopts **Project Risk Management** processes in managing project risk. The reason for this is the lack of a methodological approach to risk management in Project Management.

4. Moving from a common risk management logic such as the one adopted in **Project Management**, in which project risk management is referred to as an "of which," to a **Risk Management** logic, in which project risk management is looked at as a stand-alone discipline, requires a cultural change. This change could consist of adopting an operational standard such as that proposed by **ISO 31000**.

5. The recourse to **ISO 31000** may not be easy to apply. The limitations that lead to limit its adoption are its generality which entails a difficulty of practical application that is left to the individual subjects in charge of risk management, the need for an integration of rules and regulations that are the basis of the activity of technicians and experts and the need to use a method of project risk management that excludes the use of procedural standards.

6. Integrate Project Rating and Monte Carlo method to perform effective project management; although it turns out, at first sight, problematic, it may prove to be achievable. In order to overcome the issues that occur during the integration, it will be necessary to create for every model of Project Rating

and every type of initiative a standard **qualitative risk ranking** to be used for the transformation of the qualitative data into quantitative percentage data.

Reasoning on these conclusions, it is, therefore, possible to affirm that: if it is desired to address the problems and opportunities that the **NRRP** still poses as a topic of debate, it will be necessary to resort to Risk Management methodologies as the only processes able to guarantee the realization of "quality projects." In addition, to ensure that these methodologies will be more widely adopted, it will be necessary to overcome the problems arising from the decision to adopt **ISO 31000** as a guideline introducing a risk culture in the country that looks at Risk Management methodologies for the management of project risks. So, to adopt the change, it will not only be necessary to use dynamic and ad hoc methods rather than static and standardized ones, but it will also be of fundamental importance that the subjects involved know the projects to the point of being able to undergo an accurate evaluation of the multidisciplinary components that constitute them. This renewal, although still in progress, will require considerable time to be implemented efficiently. Furthermore, given the complexity of the interventions and the urgent nature of receiving the first **Recovery Fund** funds, many of the projects included in the **National Recovery and Resilience Plan** will have to be selected by adopting the principle of priority of intervention and evaluated on a political-social basis.

Overall, although meeting the goals envisioned and described in the **NRRP** documents does not seem simple, the conditions exist to realize an effective recovery of the economic system. For this to happen, it will be necessary to adopt

as soon as possible the strategies imposed by the new paradigm and adopt the best solutions for prioritizing the investments of the **NRRP**.

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Appendix

Learn more about Project Rating:

https://www.cmassociati.net/

F. Calabrò Massey, *Paper C*ollection-*Rating di Progetto: sistema innovativo complesso,* Torino, 2019.

Tutorials developed directly by Intaver regarding the use of RiskyProject Professional:

http://intaver.com/RiskyProjectTutorial/

Recovery Fund insights:

https://www.governo.it/sites/governo.it/files/PNRR.pdf

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