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Risk Evaluation of Production and Implementation of the Project

Abstract:

One of the key parts during the project cycle of the technical projects is also a risk evaluation of production and implementation of the project itself in all phases of the production. In this paper, we will examine the correlation of one of the risks (i.a. political risk) that are taken in consideration during risk analysis production and which are in direct correlation with the current status of country's development status in which the projects are conducted, specifically in this case of countries which are new members of EU.

Critical risk in that case is the policy and institutional aspects, including existing economic policies and development plans, organisation and management of services to be provided/developed by the project, as well as capacity and quality of the institutions involved.

Keywords:

risk evaluation; political risk; technical projects; approach from EU projects; Monte Carlo method

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Introduction

A major issue that occurs during preparation of large long term infrastructure projects is always a preparation of project documentation. If we are planning a long-term infrastructure project all risks have to be foreseen. In a country with a marginal economic growth all bigger infrastructure projects have to be partially funded by the EU. In those countries one of bigger risks is the possibility of changes in a strategical approach towards those projects due to inexistent and incoherent national long-term development strategy. Standard approach in projects funded by the EU consists of two elements. First element is based on methodology of risk analysis which is described in a CBA guide 2014, issued by the EU. Second element is an international project experience of the Consultant in a project cycle. CBA is an analytical tool to be used to appraise an investment decision in order to assess the welfare change attributable to it and, in so doing, the contribution to EU cohesion policy objectives. The purpose of CBA is to facilitate a more efficient allocation of resources, demonstrating the convenience for society of a particular intervention rather than possible alternatives. Risk analysis within EU is defined as an assessment of probability leading to changes in variables or tasks that may occur [1]. By assigning an appropriate distribution of probability to the critical variables, distribution of probability for performance indicators can be estimated if applicable. The risk analysis is done in order to assess potential impacts of risks on the project respectively the planed measures. In general, the standard approach is applied as follows:

Risk analysis is done in 5 steps.

Step 1: A list of risks will be elaborated. That list will be prepared including most relevant risks for projects focusing on implementation.

Step 2: For each risk estimate the probability for occurrence of the risk (high - medium - low) and the description of the potential events leading to it will be assessed and described. This should be done by a panel of experts knowing the project and market conditions.

Step 3: For each risk estimate the potential impact on project performance (significant - medium - insignificant) and the description in which way the risk would affect the project performance will be assessed and described (panel assessment). In fact, the impact on delay and cost will be mentioned in order to use that for an overall impact the cost estimation and project schedule. This should be done by a panel of experts knowing the project and market conditions.

Step 4: The next point includes the preparation of a risk matrix and identification of critical risks (= medium or high probability for occurrence AND medium or significant impact).

	LoLow riskw			
	Important risk, risk should be monitored	Probability		
	Critical risks, mitigation measures needed	Low	Medium	High
Impact	Insignificant			
	Medium			
	Significant			

Table 1. Impact/probability table

Step 5: The final step includes the quantitative risk analysis (Monte Carlo simulation) of only critical risks (if applicable respectively assessment of the risk and data availability), subject to data availability. Panel estimated probability for risk occurrence includes possible ranges of risks (expected, minimum and maximum

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possible values) which mean triangle probability distribution is applied.

Finally, a mitigation measures will be described and recommend for selected critical risk but also for the determined important risks in order to handle the probability and impact depending on the overall results [2].

Risk analysis preparation

The risk preparation deals with the description of the risks, the assessment and final prioritization of the risks [3].

List of risks

The main risks that are relevant for the further analysis using the partition as follows:

- Political, legal and administrative risk
- Technical (including design and construction) and operational risks
- Financial risks
- Social and cultural risk
- Environmental risk

In this paper authors will emphasize the relation of political, legal and administrative risks on technical projects.

Political, legal and administrative risks

No.	Risk	Description
1.1	Missing the target - implementing of project main goals	Delay in implementing of project main goals leads to impacts on the connected project in EU. To be expressed in month of delays.
1.2	Missing the target - implementing of project main tasks	Delay in implementing project main tasks leads to impacts on the connected project in EU. To be expressed in losses of revenues.
1.3	Missing the target- Increase of competitiveness of project	Delay in implementing project main goals and tasks leads to impacts on the connected project in EU. To be expressed in losses of revenues.
1.4	Change of strategy of project	Can cause changes in design phases and losses of already invested funds. To be expressed in monetary terms and months of delays.
1.5	Main project supplier's contract	Negotiation and signing of the contract (selection of supplier) can cause changes in project start and roll out, selection of supplier contract negotiation. To be expressed in in months of delays.
1.6	Contractor's bankruptcy (supplier)	Can cause new tendering procedures and negotiation of contracts. To be expressed in monetary terms and months of delays.
1.7	Technical allocation	Approval by the national applicable law authority. To be expressed in monetary terms months of delays.
1.8	Delays related to project goal implementation	Implementation of the technologies requires information and coordination procedures with operators of neighbouring states in depending on their technologies. To be expressed in months of delays.
1.9	Service Level Agreement (SLA) with the supplier (not signed)	SLA (defined service level) must be agreed in order to avoid additional costs within operation. To be expressed in monetary terms.
1.10	Spare part management / contract	Regulations according to the spare part handling (supplier) has to be defined and agreed (contract, negotiation, specification). To be expressed in monetary terms.

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1.11	Contracts for project implementers	Permission according to communication in the neighbouring states is necessary for starting operations. To be expressed in months of delays.
1.12.	Analysis after project implementation	Future development may be different than forecasted. To be expressed in % foreseen.

Table 2. Risk description - political, legal and administrative risks

Risk matrix

The risk matrix, as shown below, illustrates the assessment of the risks that have already been described. The assessment includes the probability, the impact and the type of impact.

	Risk	Probability (high- medium-low)	Impact (significant-medium-insignificant)	Type of impact (costs-delay)	Description
1	**Political, legal and administrative risk**				
1.1	Missing the target - implementing of project main goals	Low	Significant	Delay	The planned measures and implementation on the project main goals change due political decisions as soon as the project implementation reaches the major target.
1.2	Missing the target - implementing of project main tasks	Low	Significant	Revenues	The planned measures and implementation on the project main goals change due political decisions as soon as the project implementation reaches the major target.
1.3	Missing the target- Increase of competiveness of project	Low	Significant	Revenues	The planned increase of competiveness on the project main tasks change due political decision as soon as the project implementation reaches the major target.
1.4	**Change of strategy of project**	**High**	**Significant**	**Delay & Costs**	**Current strategy of project is defined due previously defined main goals and main tasks. The implementation strategy has not yet been finalized and approved.**

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	Risk	Probability (high- medium-low)	Impact (significant-medium-insignificant)	Type of impact (costs-delay)	Description
1.5	Main project supplier's contract	Low	Medium	Delay	Study phase is ongoing and further planning phases will detail the specification, tender process and contract negotiation
1.6	Contractor's bankruptcy (supplier)	Low	Medium	Delay & Costs	Economical (strong) suppliers are mostly responsible for systems. The tender procedure should reflect on economic and technical capability of the supplier.
1.7	Technical allocation	Low	Significant	Delay & Costs	The application (inquiry) should be started immediately in order to consider times of the authorities. In general, (EU), it should be no problem. In some cases, costs could accrue. If that could not be handled the infrastructure and equipment could not be commissioned.
1.8	Delays related to project goal implementation	Low	Medium	Delay	Information and coordination procedure must be implemented with neighboring countries. (EU benchmarks are available).
1.9	Service Level Agreement (SLA) with the supplier (not signed)	Low	Significant	Delay	The task should be considered before operation and awareness must be taken because other supplier will not solve problems with the systems. Agreement could be prepared on the basis of experiences. SLA could be negotiated and contracted (standard).
1.10	Spare part management / contract	Low	Medium	Delay	This is part of the tender documents and must be clarified before in order to keep

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	Risk	Probability (high- medium-low)	Impact (significant-medium-insignificant)	Type of impact (costs-delay)	Description
					the system running during operation (decrease in availability).
1.11	contracts for project implementers	Low	Insignificant	Delay	The coordination with neighbouring states needs to be done (EU standards, and experiences are available).
1.12	Analysis after project implementation	Medium	Insignificant	%foreseen results	Moderate growth rates forecasted and the foreseen result is partly declining. The project implementation focuses on international projects.

Table 3. Risk matrix

The risk analysis will only consider the highlighted measures of the highlighted option. The qualitative risk analysis (as initial preparation) is reflecting the stage of the project development cycle at which project is currently in: study preparation is ongoing, design has not yet been started, and works are not yet tendered. That analysis could also be done for further project phases as design or tendering [4]. The risk analysis excludes the current projects that under preparation (different phases of realization) and focuses on the overall preparation [5].

Prioritization

The prioritization can be separated as follows considering the two categories:

On the basis of the risk matrix and their assessment the prioritization is prepared as shown below [6], [7]. The prioritization includes the two categories "critical risk" and "important risk".

- Critical risks, mitigation measures needed
- Important risk, risk should be monitored and

The critical risks are summarized as follows:

- Change of strategy due political changes
- Inadequate construction cost estimate
- Lack of national finance

The risks that need to be monitored are summarized as follows:

- Missing the target - Improvement foreseen by project main tasks and goals
- Service Level Agreement (SLA) is not signed
- Inadequate site surveys and investigation
- Change in requirements
- Operational migration
- Failure existing technology
- Lack of information to technical requirements in tender documentation
- Lack of EU finance (funding)
- Inadequate supervision cost estimates
- Cost overruns during construction
- Risk prevention and mitigation

The further on report deals with risk prevention and mitigation according to he defined critical risks as well as risk that should be monitored [8].

Critical risks

Risk	Prevention and / or mitigation	Timing (short, medium, long)	Residual risk (in comparison to risk matrix)	
			Probability	Impact
Change of strategy	The project strategy implementation must be defined. Function in charge: state	Short	Medium	Significant
Lack of national finance	The national co-financing (EU funding plus national funding) must be clarified and agreed. A strategy for using (innovative) alternative financial instruments should be developed (e.g. EIB loan). Function in charge: investor, ministry	Medium	Medium	Significant
Inadequate construction cost estimation	The planning phase and further required investigations must be started on the basis of the agreed strategy. Function in charge: investor	Medium	Medium	Significant

Table 4. Risk prevention / mitigation - critical risks

Risk	Prevention and / or mitigation	Timing	Residual risk (in comparison to risk matrix)	
		(short, medium, long)	Probability	Impact
Missing the target - implementing of project main goals/tasks	The project must be implemented (promote) as fast as possible for reaching the target focus. The design phase and needed investigation must be set up. Function in charge: state, investor	Short	Low	Medium
Service Level Agreement (SLA) with the supplier (not signed)	The task should be considered / negotiated before operation. SLA could be negotiated and contracted (standard). Project experiences are available in other countries Function in charge: investor			
		Short	Low	Medium
Inadequate site surveys and investigation	The planning phases have to be started and supported by further required surveys and investigations. Function in charge: investor	Long	Low	Medium
Chance in requirements	The requirements must be detailed as soon as possible. Firstly, the general conditions e.g. technical level and step by step detailed due to the ongoing planning process. The requirements are based on the decision according to the strategy. Function in charge: investor			
Operational migration	The required interfaces must be investigated and defined (survey, study). Function in charge: investor	Medium	Low	Medium
Failure existing technology	The interfaces and the existing technology must be monitored and maintained (preventive maintenance). Function in charge: investor	Short	Low	Medium
Lack of information to technical requirements in tender documentation	The technical documentations (design) need to be on a required level and the tender document must be written by experienced experts / on the basis of the already prepared projects. The know-how	Short	Low	Medium

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Risk	Prevention and / or mitigation	Timing	Residual risk (in comparison to risk matrix)	
		(short, medium, long)	Probability	Impact
	according to the technology has to be ensured and tender specification defined. Function in charge: investor			
		Long	Low	Medium
Lack of EU finance (funding)	The preparation of the project application must be started early. EU financial technical assistance must be involved early in the project cycle to reduce time for project approval. Function in charge: state, ministry, investor	Long	Low	Insignificant
Inadequate supervision cost estimates	The supervision costs should be extended on a basis of project experiences (national / international). Function in charge: state, ministry, investor			
Cost overruns during construction	The preparation phase must be detailed with surveys, investigation and planning's. Experienced (local / international) experts must supervise the projects during and the contract with the suppliers must be under consideration. Investment cost estimates should be compared well with costs experienced with similar projects implemented in the EU in the last years. Consultations with plant and equipment manufacturers were carried out to crosscheck estimates with current market conditions. Function in charge: state, ministry, investor	Short	Low	Medium
		Long	Low	Medium
		Long	Low	Medium

Table 5. Risk prevention / mitigation - monitored risks

Results of the risk analysis (critical risks)

The risk prevention / mitigation in the last chapter show measures for the critical risks which leads changes in their assessment. Anyhow, the risks are further critical and must be considered in a quantitative analysis. The overall risk assessment is finished here by discussing the contingencies in relation to the probability of overrun / underrun the cost estimate for the implementation of project strategy [9], [10] (without design costs).

Firstly, the probability distributions of the selected critical risks have to be determined. Afterwards, the Monte Carlo method will be applied for analysing the overall cost estimate. Finally, the potential amount of contingency will be discussed by applying and illustrating the statistical results.

In general, the risk analysis including the Monte-Carlo method should give an understanding of overrunning (or underrunning) of the cost estimate (point estimate) by using a probability distribution for critical variables and illustrating the probability distribution of the overall project costs as well. In making so, the accuracy of the cost estimate can be illustrated by using a certain statistical interval of confidence.

Probability distribution

The probability distribution of the selected variables will firstly be determined. As already mentioned the distribution based on expert discussions and apply a triangle distribution for each variable, due to the missing data from the past. So, the minimum and the maximum of the variables have been determined in discussions with experts [11].

The following table presents the variables and the established distribution. After specifying the distribution of the variables, the Monte-Carlo method have been run (n = 4,000).

Risk		Minimum	Expected	Maximum
Category				
Political, legal and administrative risk	Chance of strategy [month]	0	6	12
Financial risks	Lack of national finance [month]	0	6	12
	Inadequate construction cost estimate [mEUR]	90	100	130

Table 6. Quantitative risk analysis - probability distribution (triangle distribution)

One month delay amounts to 150,000 EUR in the consideration (assumption by the Consultant on the basis of project experience).

The figure below presents the results in form of a probability distribution and a cumulative distribution of the cost estimate after the Monte-Carlo analysis. This first result doesn't include a number of contingencies.

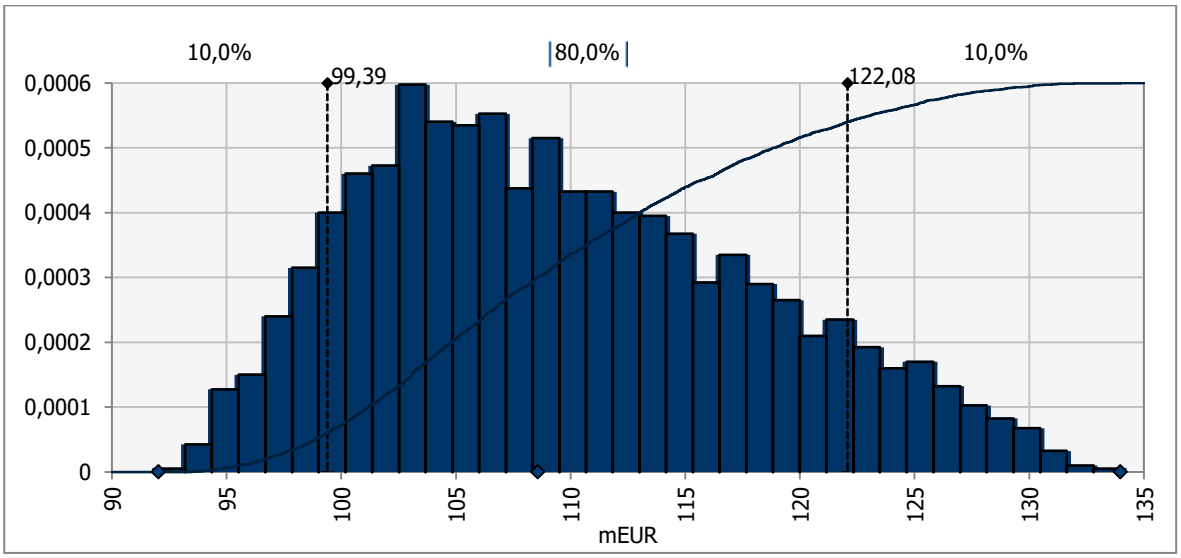

Figure 1. Quantitative analysis - probability of cost estimate (technical project) and cumulative probability (without contingencies), 80 % confidence

The value represents the point estimate of the consideration and amounts to 100 m EUR. In the case of 80 % confidence level the estimate ranges between 99 m EUR and 122 m EUR. This implies, the accuracy range (without contingencies) amounts to -1 % to 22 %. After describing the case without contingencies, the consideration will be extended to the case including contingencies. The recommended level of the contingencies depends on the assumed probability of overrun as well as underrun of the point estimate among other things. The table below presents a comparison of different estimate accuracies for several probabilities of overrun as 50 %, 30 %, 20 % as well as 10 %.

Probability of overrun	Base Cost m EUR	Contingency		Total Cost m EUR	Accuracy (80% confidence)
		Amount MEUR	%		
50 %	100	8	8	108	-9 % to 13 %
30 %	100	11	11	114	-15 % to 7 %
20 %	100	18	18	118	-22 % to 3 %
10 %	100	22	22	122	-23 % to 0 %

Table 7. Quantitative analysis - Determination of the contingencies and the accuracy in depending on the probability of overrun

The chosen contingency during the estimation of the CAPEX amounts to 25 %. The current analysis has shown that in the case of a probability of overrunning of 10 % (80 % confidence) the contingency is recommended with an amount of 22 %. This implies, the selected contingency covers the uncertainties considering the assumptions and explanations.

Conclusion

The presented analysis shows correlations and, between other risks, the risk of changing political

situations in correlation with financial risks. In cases of technical projects, especially those whom are related to long-term infrastructural investments, the risk of changing the main goals of the project due to unstable and incoherent national strategical development strategies is humongous. For that reason, this type of risk evaluation has a great impact on foreseen results. In phases of project preparation risk evaluation is the most important step in order to have a clear view of a situation. In countries, which are new members of the EU the planning of big long-term technical infrastructure projects is very delicate due to above described risks. It is extremely important to do a competent risk evaluation before closing the financial part of the project funded by the EU. [12]. Cost Benefit Analysis (CBA) is explicitly required, among other elements, as a basis for decision making on the co-financing of major projects included in operational programmes (OPs) of the European Regional Development Fund (ERDF) and the Cohesion Fund. Those funds are critical for financing long-term infrastructure projects. In conclusion, the analysis described in this article allows for the selection of projects not only on the basis of the best estimation, but also based on the risk associated with it, simply by weighing the performance with the risk [13].The expected performance, and not the modal one, is the value that should be reported in the application form for major projects requiring EU assistance, whenever a probabilistic risk analysis is carried out. In order to evaluate the result, one very important aspect is the compromise to be made between high-risk projects with high social benefits on the one hand, and low-risk projects with low social benefits on the other.

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