Managing risk and opportunities in complex projects

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Abstract. Projects is the preferred model for one-of-a-kind production. Projects may be difficult to manage due to complexity and many involved stakeholders. Stakeholders are a major source of uncertainty. Uncertainty may be both positive and create opportunities and negative giving risks. Risks and opportunities are either operational, strategic or contextual.
The traditional approach to managing risk comprise identification and analysis of risks as well as response planning and control. There is a need for a shift in mindset for managing risks. Rather than regarding risks as "evil", they should be managed because uncertainties also create opportunities. The Bermuda Risk Triangle is the intersection between operational, strategic and contextual risks. Project risk navigation is about how project leaders can navigate in this triangle to reach their objectives.
Opportunities are often more or less neglected in projects. At the most, just a few are identified.
A framework for managing opportunities is suggested. It builds on the project control variables: time, cost and scope of work. It contains a classification of eight opportunity types. Using this classification in dedicated workshops has shown to produce far more opportunities than usual.
The framework is verified in a case study. The case is the construction of the new National Museum in Oslo, Norway. Through the framework a total of 246 opportunities have been identified representing an estimated cost reduction of about 64.2 million USD.

Keywords: Project Management, Risk Management, Opportunity Management.

1 Complex Projects

The classical manufacturing typology distinguishes between flow, batch and one-of-a-kind production. One-of-a-kind production is widely applied in the shipbuilding, oil & gas and construction industry. It is also the normal approach for developing process facilities and infrastructure (for example power plants). One-of-a-kind production is also referred to as project work. Project management is a discipline in itself with its own research community. The Project Management Institute defines a project as *a temporary endeavor undertaken to create a unique product, service, or result* [1].

Projects tend to be more difficult to manage than flow or batch production. In fact, many major projects fail to meet their objectives with respect to schedule and costs.

One of the most cited examples is the Sydney Opera House, which overran its initial budget by a factor of 14 and ran 15 years behind schedule [2]. Another example is the early oil & gas development in the North Sea. The Statfjord A platform suffered a two-year delay and had a cost overrun of 222 % [3].

There are several reasons why projects are more difficult to manage:

- They may involve substantial innovation, as there might not be any proven technology available.
- As they are one-of-a-kind, there is limited experience data available for planning and execution.
- They involve cooperation amongst several organizations that may not have previous experience from working together.
- They have a high complexity involving many actors and challenging processes, organizational aspects, and logistics.

Many authors have discussed complexity. One of the first is Baccarini [4]. He defines two components of complexity: organizational and technological. Williams [5] combine these into structural complexity and adds uncertainty as a second component. Brady and Davies [6] take a systems view and make a distinction between structural and dynamic complexity, where structural complexity has to do with the arrangement of components and subsystems into an overall systems architecture. This architecture includes the system produced, the producing system, and the wider system.

Projects include a number of stakeholders. A stakeholder is a person or organization that either can influence the project execution or is affected by the project. The large number of stakeholders having different views on what the best solution is and what to deliver makes a project notoriously difficult to plan and manage. Consequently, stakeholders may have different motives for participating in. Some may tend to benefit their own interests above the outcome of the project. Thus, stakeholders create uncertainty making it difficult to plan and predict the execution of the project.

2 Project uncertainty, risk and opportunity

Uncertainty in projects is often regarded as lack of information. This means that projects carry uncertainty, and that the uncertainty will vary over the project life cycle. Some major sources of uncertainty are [7]:

- Stakeholders may have conflicting expectations.
- Project objectives may change.
- Insufficient definition of project result or development method.
- Technological constraints.
- Market conditions.
- Variations in quantities or quality.

The uncertainty sources can be classified into controllable and non-controllable factors [8]. The controllable factors are foreseeable events such as quality and deviation

of design, change of methods and technology, etc. The non-controllable factors are beyond the control of the project organization. They fall into two categories: nature (beyond the control of man) and stakeholders.

There is both negative and positive uncertainty. The negative uncertainty and its potential impact comprise a risk in the project. Likewise, a positive uncertainty and its impact, represents an opportunity for the project.

Whereas risk management has been a major focus of project managers and owners for many years, few projects has managed to exploit the opportunities that arises from positive uncertainty. Krane et al. [9] has shown that projects may have a balanced approach to manage both risks and opportunities at project start up. However, while projects sustain their effort in managing risks during project execution, there is almost no focus on opportunities.

Rolstadås and Johansen [10] classifies risks and opportunities into three categories

- operational
- strategic
- contextual

Operational risk and opportunity is due to internal circumstances in the project that typically can be controlled by the project management team. Strategic risk and opportunity is the potential impact on the project benefits. Contextual risk and opportunity is connected to circumstances outside the project that may influence the scope of work and the performance of the organization.

3 Risk navigation

The Project Management Institute defines risk management as the processes concerned with conducting risk management planning, identification, analysis, responses planning, and controlling risk [1]. This classical approach to risk management is illustrated in Figure 1. The first step is to identify risk factors. Risk analyses includes estimating the consequences of each risk factor. The final two steps are to develop an action plan and to monitor and control it.

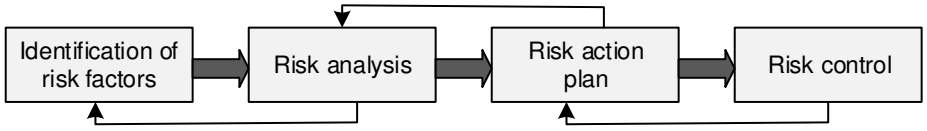

Fig. 1. Classical risk management process.

This approach is based on a perception that risk is something “evil” that should be avoided or at least mitigated. This perception of risk has led to major efforts to forecast any risk and develop plans for mitigation or elimination. Despite of this large effort, cost overruns and delays still happen.

Rolstadås et al. [11] argues that project managers need to make a shift in mindset towards a stronger focus on managing risks rather than eliminating them:

- Projects as deliverables to a means to enhance project business value.
- Uncertainties as "evil" to acknowledge the project nature as unique and uncertain.
- Projects as known tasks to be accomplished in known environments to embracing a continuum of tasks to be executed in turbulent business environment.
- Deviations from project baselines as inaccurate planning or inappropriate control to acknowledgement of deviations as being the rule.

They argue for an extended risk concept based on the three risk and opportunity categories defined above, and launches a new approach to project risk navigation. The concept is illustrated in Figure 2 and shows the three risk categories in the intersection between the project management, the project owner and the environment. The intersection of these three risk areas is called "*The Bermuda Risk Triangle*". Just as travel in the area of the Atlantic Ocean known as the Bermuda Triangle requires one to accept unknown risks, so too does the multi-year duration of a major capital project.

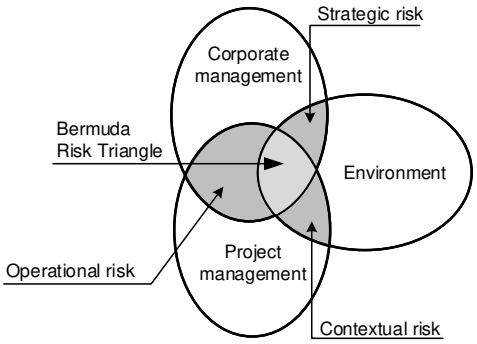

Fig. 2. A new concept for risk navigation.

Project risk navigation is about how to navigate in the Bermuda Project Risk Triangle and reach their objectives. The navigator is a framework containing three major components: the governance system, the decision process, and the strategic planning.

Although this new approach covers risk, the principles are also valid for exploiting opportunities. This follows from the arguments for a shift in mindset.

4 Hunting for opportunities

According to Davies et al. [12] innovation is often avoided in large projects due to uncertainty and associated cost escalations. Rather than seeking novel ideas and innovative approaches, the owner and the project management try to minimize risks. They rely on using proven technology and well-established procedures. In the end, this means choosing the lowest bid, transferring risk to contractors, and sticking to the

original plan. However, in opportunity management, projects cannot be reluctant to innovation and change since change and innovation are the drivers for harvesting and exploiting the opportunities.

There are several reasons why projects fail to hunt for opportunities:

- It feels safer to stick to the agreed plan rather than test new options even if there is a potential reward.
- Existing tools neglect opportunities and focus on mitigating risks.
- Exploiting an opportunity could be time consuming and costly. Thus exploiting the opportunity turns into a risk (to be avoided).
- If the project is on track, there is little motivation for the project management to seek new innovations.

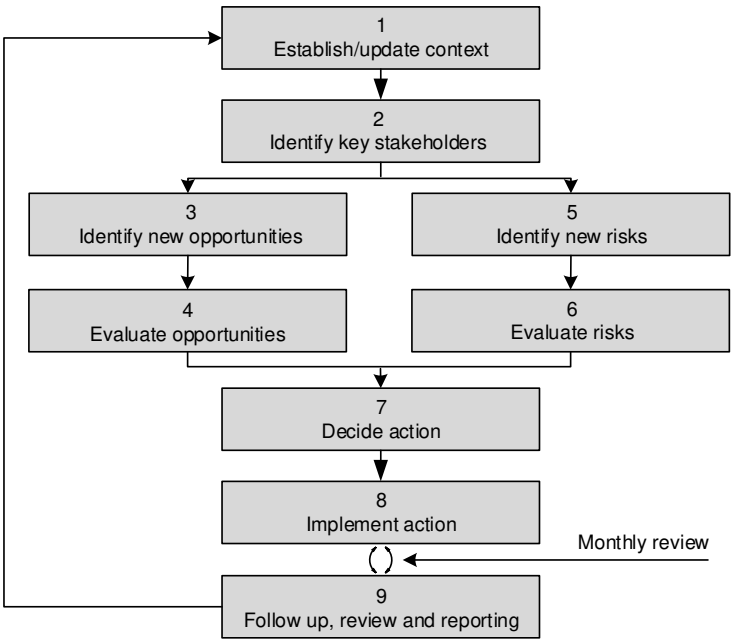

Fig. 3. Risk and opportunity management process.

The Project Management Institute defines *opportunity* as a condition or situation favorable to the project [1]. It will have a positive impact on the project objectives and represents a possibility for positive changes. Johansen et al. [13] have developed a nine-step process for identifying, analyzing and following up on project uncertainty as shown in Figure 3. In steps 1 and 2 goals and key deliverables are confirmed, and stakeholders identified. Steps 3 through 7 involve workshops for identifying, analyzing and developing measures of exploiting or controlling risks and opportunities. In steps 8 and 9 risks and opportunities are followed up over the project life cycle.

To hunt for opportunities requires ways of identifying opportunities. Normally this is achieved using brainstorming techniques at workshops involving several key stakeholders. The authors have found that there has to be dedicated workshops for identifying opportunities separate from those identifying risks. It has proven helpful to develop a framework for classification of different types of opportunities.

The suggested framework is based on the three project control variables: cost, time and scope of work as well as the project's second order effect for the project owner in the operation phase. Scope of work, however, is in this context regarded as quality. It is well known that in order to meet budget requirements, the quality level may have to be adjusted (for example by simplifying the design or by using alternative, less expensive, materials). The three control variables are often illustrated by the three sides of a triangle referred to as *the iron triangle* [14]. The idea is that the need for a change in one of the variables may be compensated by a change in one or both the other variables (the schedule may for example be compressed at a higher cost).
The classification framework is shown in Table 1. It shows eight categories. The first category describes the opportunities that are beneficial for both cost, time, and quality. Categories 2 through 4 represents the opportunities that have a combination of two out of three of cost, time, and quality. Categories 5 through 7 contain the opportunities that only gives benefits in either cost, time or quality. Opportunities that will give second-order consequences for the project owner in the operation phase are placed in category 8. This category differs from the others, as it is counted regardless if it is combined with other opportunity types.

Table 1. Framework for classification of opportunities.

Number	Opportunity category	Control variables
1	Multiple first order	Cost, Time, Quality
2	Double first order	Cost, Time
3		Cost, Quality
4		Time, Quality
5	Single first order	Cost
6		Time
7		Quality
8	Second order	Value for user/client

Eight different opportunity properties are defined: (a) reduced cost, (b) avoid cost overruns, (c) faster deliverance, (d) avoid delays, (e) higher quality, (f) avoid unnecessary high quality, (g) increased value for the client, (h) increased value for the user.

5 Verification case

The suggested framework for hunting opportunities has been verified using a case from the construction industry, the new National Museum in Norway's capital, Oslo. How the project harvested opportunities was followed over a three and a half year period (2016 – 2019) harvesting potential opportunities.

The new museum is built in the city center with demanding construction and site logistics and many stakeholders to be managed. Because of the art that will be exhibited and stored, the building is it equipped with advanced, state of the art alarm and monitoring systems, and lot of other sophisticated technical systems. The architectural and technical design is state of the art and includes several innovative solutions.

During spring 2016 the project faced problems. It was behind schedule and forecasted a cost overrun. In spite of a good uncertainty management system, there were only three opportunities left to harvest in 2015. Thus, the management system had to be adjusted. Two problems had to be solved: (1) How to chase opportunities during the execution phase and (2) How to achieve commitment at all levels of the organization?

To get the project back on track, the project management created 11 different sources/arenas with activities that facilitated opportunity hunting such as formal workshops and informal café dialogues. Six separate opportunity studies on the largest contracts (believed to have the largest potential) were organized.

By April 2019, 246 opportunities have been identified, and the project has an estimated cost reduction of about 64.2 million USD. 175 of the 246 identified opportunities were harvested. A harvested opportunity is considered as an opportunity the project made an effort to realize. Table 2 shows the number of opportunities harvested for the first order opportunities. 56 % were assumed to have an effect on cost, 62 % on time and 32 % on quality.

Table 2. Number of first order opportunities harvested.

Cost		Time		Quality	
Reduced cost	Avoid cost overruns	Faster deliverance	Avoid delays	Higher quality	Avoid unnecessary high quality
105	33	90	62	27	51
138		152		78	

Based on the framework, there are two important conclusions for the museum case: 1) opportunities related to cost and time are dominant, and 2) it looks like there is less focus on opportunities that are beneficial for the National Museum in the long run.

The project management rated the performance objectives as 1) cost, 2) quality, 3) time. The frequency of cost, time, and quality in the framework show that the harvested opportunities are not aligned with the performance objectives. However, the focus was on reducing time and cost at the time of implementation of the new opportunity management approach, and one could argue that the strategy was successful. The project had to get back on track with respect to cost and time as the quality standard already were set extremely high. This might explain why most of the opportunities were cost- and time-related in the construction phase and why these opportunities are so dominant in this case. Another reason is that cost and time is more straightforward to measure than quality, which could make such opportunities easier to define during identification.

6 Conclusion

Managing uncertainty is of crucial importance for a complex project to be successful. However, it is manly the negative uncertainty (creating risks) that is considered in most projects. The positive uncertainty (enabling opportunities) is often neglected. To remedy this, a framework for managing opportunities is suggested. It uses an opportunity classification system in a number of formal and informal workshops. In this way, almost the same number of opportunities as risks can be identified.

Future project managers must pay more attention to the harvesting of opportunities, as they are crucial to enhance projects benefits or to bring projects running over time and budget back on track. However, this requires a new mindset, both with the project organization and the project owner.

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