RISK MANAGEMENT IN THE DIFFERENT PHASES OF A CONSTRUCTION PROJECT – A STUDY OF ACTORS’ INVOLVEMENT

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ABSTRACT

The results from a questionnaire survey of risk management in the different phases of a construction project are presented. The participants of the study were clients, contractors and consultants working in Sweden. We analysed the involvement of these actors in the project phases, their roles in the risk management process in particular and their influence on risk management. We show that the planning and production phases of a construction project are the most important for risk management, wherein risk identification, assessment and response take place. Moreover, collaboration in terms of risk management between the actors is most intensive in these phases. Contractors participate more actively in the risk management process in comparison with other actors and have the largest influence on project risk management. Despite the recognised importance of the early phases in the project, our study shows a very low degree of risk management activity in the programme phase.

1. INTRODUCTION

Construction projects are usually characterised by many varying risks. Being able to manage risks throughout the construction process is an important and central element preventing unwanted consequences. Risk management is also decisive for achieving a good final result with secure economy. Many different actors are involved in a construction project and often they have no or limited experience of earlier collaboration with each other. In many projects there is an attempt by actors to try to avoid risks as far as possible and let somebody else in the value chain deal with them. Considering the effects that risk management and risk sharing have on project goals in the form of both quality and economy, these processes ought to take place in an open and conscious way. In each phase of a construction project, namely programme, planning, procurement and production, the management of a specific risk should be allocated to the party that has the best corresponding qualifications.

One of the problems identified in the reports of Swedish Construction Cost Delegation and Construction Commission (SOU, 2000; SOU, 2002) is that many actors are involved only in some of the project’s phases. They often focus on short-term economic results and protect their own interests rather than the project overall. This leads to a less effective risk management process. Little attention in the
research community so far is paid to identifying the roles of individual actors in risk management through the project’s different phases.

The objective of the paper is to analyse the risk management process in a construction project from the perspective of the client, the contractor and the consultant. In particular, we examine the ways and extent to which the actors are involved in risk management through the different phases of the project. The study is based on a literature review and the results of a questionnaire survey of construction project actors.

The paper is organised as follows. In section 2 we overview relevant literature. In section 3 the research methodology of the study is described. Section 4 presents the result of the questionnaire survey and analyses risk management process in the projects’ different phases. Discussion and directions for future work are presented in section 5. The concluding remarks follow in section 6.

2. REVIEW OF RELATED LITERATURE

2.1. Risk and risk management in construction

There are several definitions of the project risk in the literature (e.g. IEC, 2001, PMI, 2000, Baloi and Price, 2003, Barber, 2005). A formal definition is given in the international standard IEC 62198 as a combination of the probability of an event occurring and its consequences for project objectives. Ward and Chapman (2003) discuss the concept of risk in greater detail and suggest using the more general concept of uncertainty. A questionnaire survey conducted by Akintoye and MacLeod (1997) shows that the majority of project actors perceive risk as a negative event. More detailed literature review on risks in construction is presented in Osipova and Apleberger (2007).

Project risk management is a formal process directed to identification, assessment and response to project risks. The process is defined differently in research literature (e.g. Flanagan and Norman, 1993; Uher and Toakley, 1999; PMI, 2000; Chapman and Ward, 2003). However, all definitions agree that the aim of project risk management is to maximise opportunities and minimise the consequences of a risk event in the construction project. The Guide to the Project Management Body of Knowledge (PMI, 2000) identifies four main steps in the risk management process: risk identification, risk assessment, development of risk response and management of risk response. Several authors develop more detailed models. Baloi and Price (2003) use the model of seven steps: risk management planning, risk identification, risk assessment, risk analysis, risk response, risk monitoring and risk communication. Chapman and Ward (2003) introduce the SHAMPU model, which consists of nine phases. Del Cano and de la Cruz (2002) present a generic project risk management process of eleven phases, which can be used in large and complex projects. For the purpose of this research we use a simplified risk management process of three main steps: risk identification, risk assessment and risk response. The reason for the simplification is that this model is well-known for the project actors and frequently used in practice.

The goal of the risk identification process is to decide on potential risks that may affect the project. There are several approaches for classifying project risks and risk sources (Leung et al., 1998; Tah and Carr, 2000; Baloi and Price, 2003; Li et al.,
The main categories are financial, economic, managerial, legal, construction, design and environmental risks. During the risk assessment the identified risks are evaluated and ranked. The goal is to prioritise risks for management. Baccarini and Archer (2001) describe a methodology for the risk ranking of projects, which allows for an effective and efficient allocation of the resources for management of project risks. The JRAP model proposed by Öztas and Ökmen (2005) is a pessimistic risk analysis methodology, which is effective in uncertain conditions in construction projects. The risk response process is directed to identifying a way of dealing with the project risks.

Several surveys conducted among the construction industry actors (Akintoye and MacLeod, 1997; Uher and Toakley, 1999; Lyons and Skitmore, 2004) show that checklists and brainstorming are the most usable techniques in risk identification; subjective judgment, intuition and experience are used mostly in risk assessment; and transfer, reduction and avoidance are the most applied methods for risk response.

2.2 The roles of the project’s different phases in risk management

Traditionally, a construction process is divided into four main phases: programme, planning, procurement and production. In the programme phase the client has an idea about the project and analyses conditions for its execution. During the planning phase the architects produce construction drawings according to the client’s requirements. In the procurement phase the parties sign the contract. Finally, the contractor executes the job in the production phase.

Since it is impossible to foresee all project risks in the programme phase and due to the tendency of the identified risks to change during project implementation, joint and consistent risk management is required throughout all project’s phases (Rahman and Kumaraswamy, 2004). Motawa et al. (2006) propose a model, which helps in determining potential changes in the project based on available information in the early stages of the project. Baccarini and Archer (2001) introduce a methodology for a risk rating process in the procurement phase, which allows the effective and efficient allocation of resources for project risk management.

Several authors highlighted the importance of the early phases in project risk management since the decisions taken in these phases often have a significant impact on the final result (Kähkönen, 2001). However, according to Uher and Toakley (1999), the actual usage of risk management techniques in the early phase is very low.

Lyons and Skitmore (2004) conducted a survey where one of the aspects was the use of risk management in each of the project phases. The results showed that risk management in the planning and production phases was higher than in the programme phase. Risk identification and risk assessment were more often performed in the risk management processes than risk response.
3. RESEARCH METHODOLOGY

The study involves nine construction projects recently performed in Sweden (Table 1). In order to obtain an accurate picture, the projects included in the study satisfy the following requirements:

- the projects are located in large and small cities;
- they use different forms of contract and collaboration, i.e. performance-based contracts, design-build contracts and partnering;
- the types of the projects are building and civil engineering;
- all projects are medium-sized (between 5 and 100 MSEK).

Table 1. Characteristics of construction projects included in the study

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Location</th>
<th>Type of the project</th>
<th>Form of contract/collaboration</th>
<th>Contract amount (MSEK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Norrbotten</td>
<td>Building</td>
<td>Design-build</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>Norrbotten</td>
<td>Building</td>
<td>Performance-based</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>Norrbotten</td>
<td>Civil Engineering</td>
<td>Design-build</td>
<td>53</td>
</tr>
<tr>
<td>4</td>
<td>Norrbotten</td>
<td>Road</td>
<td>Performance-based</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Norrbotten</td>
<td>Road</td>
<td>Performance-based</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Stockholm</td>
<td>Building</td>
<td>Design-build</td>
<td>81</td>
</tr>
<tr>
<td>7</td>
<td>Stockholm</td>
<td>Building</td>
<td>Design-build</td>
<td>48</td>
</tr>
<tr>
<td>8</td>
<td>Stockholm</td>
<td>Civil Engineering</td>
<td>Performance-based</td>
<td>95</td>
</tr>
<tr>
<td>9</td>
<td>Stockholm</td>
<td>Building</td>
<td>Partnering</td>
<td>15</td>
</tr>
</tbody>
</table>

As the objective of the study is to get a picture of the risk management process from different actors’ perspectives, a questionnaire survey was chosen as the most appropriate research method. The survey sample comprised clients, contractors and consultants. Within each group we identified those persons who worked with risk management in a particular project. The respondents from the client’s side are the representative signing the contract and project manager. From the contractor’s side the respondents are the representative signing the contract, site manager and estimator. Finally, the respondent from the consultant’s side is the architect or design manager.

A draft questionnaire was developed consisting of five sections. The first section contained general questions about the respondent. In the second section, the aspects of the risk management process through the different phases of the project were covered. The third section investigated relationships between the actors in the project. The fourth section focused on software management systems, which the company uses in the risk management process. The fifth section was a concluding one for miscellaneous comments regarding the risk management process in the project.

We organised two workshops where we met about 50% of prospective respondents and presented the research project and the objectives of the survey. The workshop participants were given an opportunity to answer the draft questionnaire and give their comments on the content. Following the workshop, the final version of the questionnaire was developed and sent in the electronic form to the respondents. After the questionnaires were completed, the answers were analysed using the statistical processing software, SPSS, and Microsoft Excel.
4. RESULTS OF THE SURVEY

In total, 54 questionnaires were sent and 43 responses were received, resulting in a response rate of 80%. From the received responses, 36 were completed questionnaires and seven respondents explained the reasons for non participation. A response rate of 100% was for those people who attended the workshop. This shows that the respondents who were aware of the survey objectives were more interested in taking part in the project. The sample composition aggregated according to actors’ roles in the project is shown in Figure 1.

4.1 Respondents

Analysis of gender distribution confirms that the Swedish construction industry is traditionally male-dominated sector. 34 survey participants are men and two participants are women. The age distribution shows that 89% are over 41 years old. Most of the respondents (92%) have more than ten years experience in construction industry, and 64% have more than 20 years of experience. 44% of survey respondents have a university degree in construction, 53% finished upper secondary school, and only one person has vocational training only. 33% respondents participated in risk management or project management courses within their organisations or during the period of university studies.

Despite a relatively high education level and large experience, the majority of the respondents (75%) estimate their knowledge of risk management as fair. Table 2 summarises the risk management knowledge within each group of actors.

Table 2. Knowledge of risk management

<table>
<thead>
<tr>
<th>Role in the project</th>
<th>Client</th>
<th>Contractor</th>
<th>Consultant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Fair</td>
<td>10</td>
<td>14</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Advanced</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
4.2 Risk management in the different phases of the project

Figure 2 shows that the majority of the respondents (32) participated in the production phase. For the contractors it is quite natural because they are always involved in the production phase and very seldom in the programme phase. Therefore contractors' participation increases as the project goes forward: one contractor participated in the programme phase and 16 in the production phase. It was quite unexpected that only seven clients participated in the programme phase compared to 14 clients in the production phase. This may be partially explained by the types of the projects. Often there is no programme phase in civil engineering projects. Therefore, most of the respondents from this group answered that they did not participate in that phase. All four consultants participated in the planning phase and two of them followed into the production phase.

![Figure 2. Participation in the project phases](image)

When the respondents were asked to estimate the importance of risk management in every phase of the construction project (Figure 3), the estimates were similar in both the client and contractor groups. The production and planning phases were identified as the most important for the management of risks. Then the procurement and programme phases follow. Consultants' estimates differ from those of clients and contractors. Overall, we observe that they underestimate the importance of all phases compared with the other actors. However, the planning and production phases are identified by consultants as the most important. From this distribution we can conclude that many actors link risks to the production phase.

![Figure 3. Importance of risk management in the different phases](image)

Figure 4 illustrates how many actors carried out risk management processes systematically in their projects. The most active group is contractors, where all respondents identified and assessed project risks and 94% performed risk response systematically. In the client group 86% identified risks, 71% assessed them and only 57% systematically responded to project risks. The explanation of low risk response rate may be that the clients let other actors in the value chain deal with identified risks. Consultants are the most passive actors when it comes to project risk.

![Figure 4. Carried out risk management processes systematically in their projects](image)

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2 Scale is between 1 and 4, where 1 is unimportant, 2 – not so important, 3 – fairly important, 4 – very important
Among consultants only 33% identified risks and responded systematically, and none assessed project risks.

Figure 4. The risk management processes systematically performed in the project

### 4.2.1 Risk identification process

Risk identification (Figure 5) was mostly performed in the planning and production phases. The earlier risks are identified, the less is the probability that they occur. Despite this only seven respondents answered that risk identification was performed in the programme phase. Most of the clients indicate that risk identification was carried out in the planning phase, whereas contractors mostly identify risks in the production phase.

Figure 5. Risk identification in the different phases

In the programme phase 75% of the respondents answered that risks were identified by the client. In the planning phase 39% responded that risks identification was performed jointly by all actors and 25% responded it was performed by the client and the consultant. In the procurement phase the contractor plays the most important role in risk identification (52%). In the production phase risks were identified by the contractor (39%) or jointly by all actors (39%).

### 4.2.2 Risk assessment process

Figure 6 shows that risk assessment has a similar tendency as the risk identification process: the majority of the respondents perform it in the production phase. However, the procurement phase is more important for the risk assessment process than for risk identification and risk response. This is because the risk premium is calculated in the procurement phase and therefore it is important to assess earlier identified risks.
Figure 6. Risk assessment in the different phases

Similarly to the risk identification process, the risk assessment in the programme phase is performed mostly by the client, in the planning phase jointly by all actors or by the client and consultant. However, the contractor’s involvement in the risk assessment in the planning phase was higher than in the risk identification. The procurement and production phases do not differ much from the risk identification process: in both phases the contractor plays the most important role.

4.2.3 Risk response process

Risk response (Figure 7) is also associated with the production phase. Both the clients and the contractors mostly manage risks in this phase. This is due to the traditional approach in the construction industry: contractors do not put enough effort into preventing problems and solve them as they appear in the project.

Figure 7. Risk response in the different phases

In the programme phase, similarly to the risk identification and assessment processes, risk response is performed by the client. In the planning phase the client together with the consultant responded to the project risks. In the procurement phase risk response is performed mainly by the contractor. In the production phase the role of the contractor is large and the degree of joint risk management is high.

4.3 Collaboration in managing risk and actors’ influence on the risk management process

In the questionnaire we define the term collaboration as joint work in risk management process. Almost all respondents had collaboration in risk management with other actors in the project: 11 clients, 13 contractors and three consultants. Seven respondents (three clients, three contractors and one consultant) answered that no collaboration in risk management existed in the project. Evaluations\(^3\) of collaboration (Table 3) vary from “fairly good” to “very good”.

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\(^3\) Scale is between 1 and 4, where 1 – very bad, 2 – fairly bad, 3 – fairly good, 4 – very good.
Table 3. Evaluation of collaboration in risk management

<table>
<thead>
<tr>
<th>Role in project</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>3.55</td>
</tr>
<tr>
<td>Contractor</td>
<td>3.38</td>
</tr>
<tr>
<td>Consultant/ Architect</td>
<td>3.33</td>
</tr>
</tbody>
</table>

The degrees of communication of known risks and opportunities between actors in the procurement phase are presented in Table 4. Overall evaluations are not high and vary between "little detailed" and "fairly detailed”. The contractors answered that the client communicated known risks moderately (2.06). On the contrary, the clients state that their communication of known risks is higher (2.73).

Table 4. Degree of communication of known risks and opportunities between actors in the procurement phase

<table>
<thead>
<tr>
<th></th>
<th>Clients’ communication</th>
<th>Contractors’ communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>2.73</td>
<td>2.69</td>
</tr>
<tr>
<td>Contractor</td>
<td>2.06</td>
<td>2.39</td>
</tr>
<tr>
<td>Consultant/ Architect</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Total</td>
<td>2.36</td>
<td>2.53</td>
</tr>
</tbody>
</table>

Figure 8 presents the respondents’ judgement of their own and other actors influence on risk management in the project. The results show that the contractor has the largest influence on risk management from the perspective of all actors. It is interesting that even the clients estimate the contractors’ influence to be larger than their own. This can be linked to the Figure 3, where the actors connect risk management to the production phase. The influence of the consultant is surprisingly low despite the fact that the planning phase is considered to be very important by all actors.

Figure 8. Influence of the actors on the risk management process in the project

The existence of collaboration in risk identification, risk assessment and risk response is shown in Figure 9. Risk identification (RI) is the process where collaboration existed according to most of the actors: 82% of clients, 92% of contractors and 67% of consultants answered that they collaborated identifying the project’s risks. During the risk assessment process (RA) both the clients and the contractors collaborated with each other, while only 33% of consultants answered that collaboration existed. The risk response process (RR) has a lower degree of collaboration according to the contractors: 62% of them had collaborated in taking care of risks.

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4 Scale is between 1 and 4, where 1 – not at all, 2 – little detailed, 3 – fairly detailed, 4 – very detailed.
5 Scale is between 1 and 4, where 1 – very small, 2 – fairly small, 3 – fairly large, 4 – very large.
The existence of collaboration in the projects’ different phases is presented in Figure 10. It shows that in the programme phase there was minimum collaboration in risk management. Only 14% of clients, the most active participants of the programme phase, answered that collaboration existed in the phase. In the planning phase 70% of clients, 75% of contractors and 100% of consultants collaborated in risk management. This result can be linked to the importance of risk management in that phase, which was ranked high by the actors. In the procurement phase the collaboration between the clients and the contractors in risk management existed in half of the projects. In the production phase the collaboration between the actors is the most intensive because many risks appear in this phase and should be eliminated to achieve a good final result.

Figure 10. Existence of collaboration in risk management in the project’s phases

5. DISCUSSION AND FUTURE WORK

In the previous section we presented the results of the questionnaire survey. In particular we focused on the following issues: the actors’ participation in the project phases, importance of risk management in different phases, risk identification, analysis and response through the phases, collaboration in managing risks and influence of the actors on the risk management process. This section aims at discussing the results and developing directions for future research.

We found that participation in the different phases of a project was governed by the actors’ roles in the construction process. In particular all contractors participated in the production phase and all consultants participated in the planning phase. Production was the phase where the majority of respondents participated, while the participation in the programme phase was very low. Neither contractors nor clients were sufficiently involved in the programme phase. The planning and production phases were identified by all actors as the most important for risk management. In
these phases risk identification, risk assessment and risk response were mostly performed. An important question to investigate further is: what the actors can gain by participating in all phases of the project? We foresee that participation of the actor in all phases of the construction process leads to more effective risk management through more intensive information and knowledge exchange and earlier identification and assessment of potential project risks.

The results of the survey show that the roles of the actors in risk management processes are strongly connected to their participation in the project’s phases. Thus risk identification, risk assessment and risk response were mostly performed: in the programme phase by the client; in the planning phase jointly by the client and the consultant; in the procurement and production phases mostly by the contractor. The planning and production phases are those where joint risk management was mainly used by the actors. We suggest that the procurement phase should play a more important role in joint risk management. The risk management in the project should be based on the actors shared view of what the risks are and who should carry them. One model might be that the client prepares its view on the risk aspects of the project and the tendering contractor responds with its respective risk analysis. The total picture of the client’s and the contractor’s risk analyses and a shared insight will then form the basis of a conscious risk management process and risk allocation in the contract. There is a clear indication that collaboration through all phases of the project increases the probability that a specific risk is managed by the actor who has the best corresponding qualification.

Collaboration in risk management was evaluated high by all actors and was most intensive in the production phase. On the contrary, evaluations of actors’ communication of known risks in the procurement phase are low. In particular the contractors state that the client communicates the risks on a low level. Collaboration between actors was very strong in the risk identification and risk assessment processes. In the risk response process the degree of collaboration decreases significantly according to the contractors’ opinion. This indicates that the project’s actors protect own interests and try to transfer the identified risks to other actors.

According to our studies contractors were most active in performing risk identification, assessment and response systematically in the project. Moreover, they had the largest influence on risk management in the project from the perspective of all actors. Consultants had very low influence on project risk management. They were not familiar with risk identification, risk assessment and risk response. However, it is difficult to generalise the results because the consultant group is very small in the sample. We suggest that the consultants should be involved more in risk management because design is a very significant risk source in a construction project.

In our future work we will perform a series of interviews with the construction project actors. The goal of the interviews is to investigate deeper the possible changes in a traditional construction process, where risk management is performed in late phases. Finally, it is important to understand the factors, which determine whether or not the actors consider an open discussion on risk management and risk sharing as beneficial.
6. CONCLUSIONS

Considering the effects that risk management has on a project’s goals in the form of quality and cost, it should be an open and conscious process through all phases of the project. The aim of the paper was to examine the ways and extent to which the actors are involved in risk management through the different phases of the project. For this purpose we conducted a questionnaire survey of clients, contractors and consultants. The overall conclusion is that, according to project actors, risk management is strongly linked to the production phase. Most of risk processes are performed in that phase and contractors tend to be the most active group with a large influence on the risk management process. These findings confirm some results of previously conducted surveys. Despite of the recognised importance of the programme phase, this study showed that this phase does not play an important role in the risk management process.

7. ACKNOWLEDGEMENT

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8. REFERENCES


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