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Abstract

Project risk management has been intensively discussed in recent years. Projects are becoming shared efforts of multiple parties – construction industry is a good example of an area, where the project outcome is delivered in an extremely complex actor network. Still, research on how the project risk management should be adopted to the network environment is scarce. This study's objective is to identify the risks that are caused by the network structure and the ways to manage risks in the co-operation of the whole project network. The focus of the study is put on the informal risk management means. The purpose is to emphasize other than legally binding contracts as risk management means.

The study was conducted in the summer 2005, when altogether 14 interviews were made in two different construction projects. Interviews were targeted to the subcontractor's representatives, but also main contractor's and client's representatives were interviewed. Literature searches were done by using HUT library materials and databases.

A lot of the risk management research is targeted to the construction projects, which are seen as extremely risky projects with highly inflexible risk management by contracts. Number of studies are stressing the importance and superiority of the co-operation and less formal risk management means, but concrete methods are not introduced. In addition, the use of already developed risk management methods is modest at construction sites.

Network governance literature supports the idea of less formal co-operation and risk management in the project networks. Many benefits can be gained if project network actors are engaged in longer-term co-operation. For example, using these "softer", informal, risk management means, transaction costs can be significantly reduced by cutting the need for expensive contracting efforts.

Empirical study was used to show the application area for risk management derived from the network governance literature. Based on this, a co-operative risk management model for project networks was formed. The basic idea of the model is to take the advantage of higher level co-operation and to switch a project risk management in construction networks from dyadic relationships more towards the network-level co-operation. According the understanding gained during this study it is suggested that by enabling more co-operative risk management methods, the project risk management will become more efficient and identified inefficient and costly network governance practices – serving as a sources for risks– would be reduced.

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1 Introduction

1.1 Background

In recent years, intensive research and development has been done in the area of project risk management. It is widely recognised as one of the most critical procedures and capability areas in the field of project management[1]. Voetsch, Cioffi, and Anbari[2] found a statistically significant relationship between management support for risk management processes and a reported project success. However, shortcomings and improvement opportunities in this field[3] have been identified. Some of the shortcomings are related to the ever increasing complexity of projects[4]. Subcontracting is expanding since many companies are focusing solely on their core businesses, which results in more complex project networks and greater numbers of project participants. The scarcely studied viewpoint in the project risk management field is related to this complexity. Although the interaction between project actors occurs at many different levels, research done to study how networks act in preventing or mitigating risks is moderate.

Construction projects are characterized as very complex projects, where uncertainty comes from various sources[5]. Construction projects gather together hundreds of stakeholders, which makes it difficult to study a network as a whole. But at the same time, these projects offer an ideal environment for network and risk management research. Additionally, construction projects are frequently used in management research, and several different tools and techniques have already been developed and especially for this type of project. However, there is a gap between risk management techniques and their practical application by construction

[1] E.g. Artto, K., Kujala, J., Martinsuo, M., 2005, Royer, P.S., 2000 and Turner, J.R. , 1999

[2] Voetsch, R.J., Cioffi, D.F., Anbari, F.T., 2004

[3] Kähkönen, K. in Artto, K., Kähkönen, K., Management of Uncertainty, unpublished

[4] Cheng, E. W. L., Li, H., Love, P.E.D., 2001

[5] e.g. Miller, R., Lessard, D., 2001

contractors[6]. This study tries to find reasons for this gap and works to decrease it. Special applications for construction projects are discussed in the literature review.

This study is based on the assumption that by understanding better both the relationships in a project network and risks related to the network structure, project risk management can be more effective. It has already been recognized that a clear understanding of the risks born by each participant leads to better risk allocation[7]. The objective of the study is to find means of risk management that can be utilized by the network and to make new suggestions on the use of these risk management methods. It is of a particular interest to find the means to manage those risks that are the most effectively managed with the co-operation of several project actors. Initially however, the relationship between the existence of a network and the existence of risks needs to be established.

This study was conducted in the later part of the year 2005 as a part of the "Innovative Cooperation in Construction Projects" (InCoPro) research project. The study started in June 2005 with a literature review and interviews that were made during July and August 2005. The study was completed in March 2006.

1.2 Research Objectives, Questions and Scope

The objective of the study is to find risk management means for the risks that are associated with the project network structure. And to make improvement suggestions on the use of these risk management methods. Currently, a vast number of risk management methods exist, but none of them pertain to a situation where multiple actors are required to work together on one project. The first subsidiary objective is to identify the risks that are caused by structuring the work in increasingly complex project networks. The purpose is to identify the risks in project networks

[6] Baloi, D., Price, A.D.F., 2003

[7] Zaghloul, R., Hartman, F., 2003

by using existing literature in combination with interviews. A second subsidiary objective is to find existing methods for project risk management in construction project networks by interviewing central actors working on two different construction projects.

Emphasis is put on the risks caused by the network structure and the focus will be put on the co-operative ways to manage these risks. For these reasons, it is necessary to take a closer look at organisation theory and the dynamics of co-operation in project networks. An organisation research area called network governance examines the interaction between different actors in a network and the determinants of the management methods in networks. Thus the third subsidiary objective is to study and explain some risk management means in project networks by the network governance theory. It is assumed that these network governance viewpoints can offer valuable knowledge about the risks related to the interaction of the project actors and the means how to manage these risks.

Research questions (figure 1) are formulated in the following way; the first three questions supporting two main ones (numbers 4 and 5).

1. What is project risk management?
2. What is project network governance?
3. What are project risks in networks?
4. How are risks managed in a project network?
5. What co-operative ways exist to manage risks?

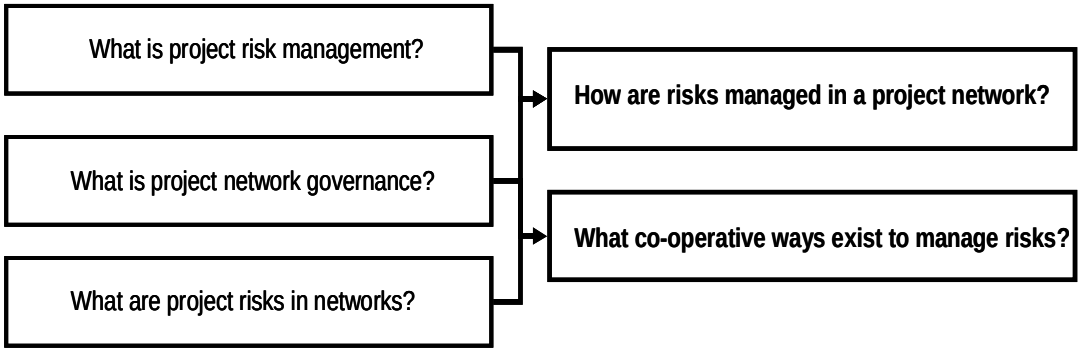


Figure 1: Research questions

An answer for the first question describes what the project risk management is today. Literature from the project risk management area is wide, but poor from the network point of view in managing project risks.

Based on existing studies and network theory, an answer to the second question about project network governance will give a brief overview of the concept of network governance. The concept of network governance is seen as important in this study's context, since the purpose is to discover how network dynamics affect risk management processes and methods.

The third question responds to the pre-set assumption that a network is a source for various risks. While doing the preliminary study plan the construction industry representatives were convinced that these networks do cause risks. This is the first phase of the study where literature material alone does not provide a thorough picture and empirical material needs to be collected.

The fourth and fifth questions can be seen as the key questions of the study. The objective of the entire study is to go beyond a single actor viewpoint and to find ways to manage the risks in networks. The assumption is that the most efficient means to manage these risks are co-operative. In order to gain new insights, answers to the preceding questions will be based on the combination of the literature and the empirical materials.

The assumptions made prior to the start of the study are as follows. Network structure is a significant source of project risks, but this is not yet recognised at either at the project site or in the literature. Co-operative means of managing these risks are used, but they are neither structured nor do actors recognise these strategies as means of risk management. Instead, main contractors take the lead role in risk management. One construction project manager used the words "grey area" to describe risk management in construction sites. He was referring to the many procedures that are

used by the project participants, but are not documented in any way. Such insights indicate that some informal methods are used.

The scope of the study is restricted to the informal project risk management means; informal referring to all risk management means other than legally binding contracts. Earlier studies concerning risk management in construction projects have found that risk management in the construction industry relies heavily on contracts, and contract clauses are estimated to raise project costs by 8-20%8. Contractual structures are also thought to be the main source of inflexibility and have a significant negative impact on the actor relationships9. This gives clear financial justification for the study of informal means as a one possible way to decrease contractual extra costs and increase flexibility. Contracts in this study are treated only as a one risk management mean, but not analysed any further. In the focus of the study are those risks that relate to the successful project execution, known as operational risks. Therefore also interviews are limited to those network partners that take part in project execution phases. Interviewees are representatives of subcontractors, the main contractor and a client. Empirical material is collected from two construction projects, both new building sites located in the Helsinki area. The study focuses on the construction industry.

[8] Hartman, F.T., 2000

[9] e.g. Floricel, S., Miller, R., 2001

1.3 Research Methods

The study begins with a literature review. The purpose of the literature part is to answer the first two research questions and to support the three other ones. The literature review will give an overview of both the basics of the network theory and project risk management, as well as their applications in the specific construction projects under discussion. To conclude the literature review a synthesis of present understanding and the management of the risks caused by network structure is provided. Then, the empirical part will continue to fill the assumed gap between the present state of risk management and risks to the network at construction sites in the literature. Empirical study includes 14 interviews made to representatives of the two different construction projects in Helsinki Area. Of the 14 interviews 7 are made to the subcontractors' representatives, other interviewed parties include the supplier, the customer, the main contractor and the designer. Interviews were conducted in August 2005, and were aimed at gathering the interviewees' experiences from risk management processes and to gain an understanding of what kinds of risk management methods are used in construction sites. The empirical process is described more in detail in section 5.1.

The literature material consists of several recent articles published in international journals and a few related books. Literature sources were found using HUT library databases, search words used are presented in table 1. Some words were used as single search words, but many of them only in sound combinations of these words. The references in articles were checked for related literature sources.

Table 1: Search words used for literature searches

alliance	network
allocation	partnering
construction	partnership
dynamic networks	project
governance	reward system
identification	risk
joint risk management	sharing
management	

In addition, three last volumes (2002, 2003, 2004 and the first part of 2005) of few well known academic publications in the research area were examined to find related articles. Publications were "International Journal of Project Management", "Project Management Journal", "Strategic Management Journal" and "Construction Management & Economics".

1.4 Definitions

Risk (in this study's context): an uncertain event or condition that results from the network form of work, having an impact that contradicts expectations. An event is at least partially related to other actors in a network.[10]

Risk source: things that can cause variation from what is planned or expected[11]

Project risk management: includes maximizing the results of positive events and minimising the consequences of adverse events.[12]

Project network: a set of relations, where no single actor is a legitimate authority for the network as a whole, the network is open in the sense that there are no definite criteria by which the boundary of the network may be identified and controlled and where the network is temporarily limited, dynamically changing and (partially) reconstructed from one project to the next.[13]

Actor: a network member, a party or an individual who has one or more ties to other network members.

Network in this study: those actors that have a role in the project execution phase. Here namely a main contractor, a client and subcontractors.

[10] Artto, Kähkönen, 2005

[11] adapted from Ward, S., Chapman, C., 2003

[12] Artto, Kähkönen, 2005

[13] Hellgren, B., Stjernberg, T., 1995

Network Governance: network governance involves a selected, persistent and structured set of autonomous firms (as well as non-profit agencies) engaged in creating products or services based on implicit and open-ended contracts to adapt to environmental contingencies and to coordinate and safeguard exchanges. These contracts are socially – not legally – binding.[14]

Informal means: Those means to manage project risks that are not legally binding, i.e. all other means than contracts.

1.5 Structure of the Study

The structure (figure 2) will support the objectives of the study by first providing some insight into present knowledge, introducing both risk management and network theories. The study will continue to present the findings from the interviews and finally to combine these two areas together to detect the similarities and existing gaps and explain why they exist.

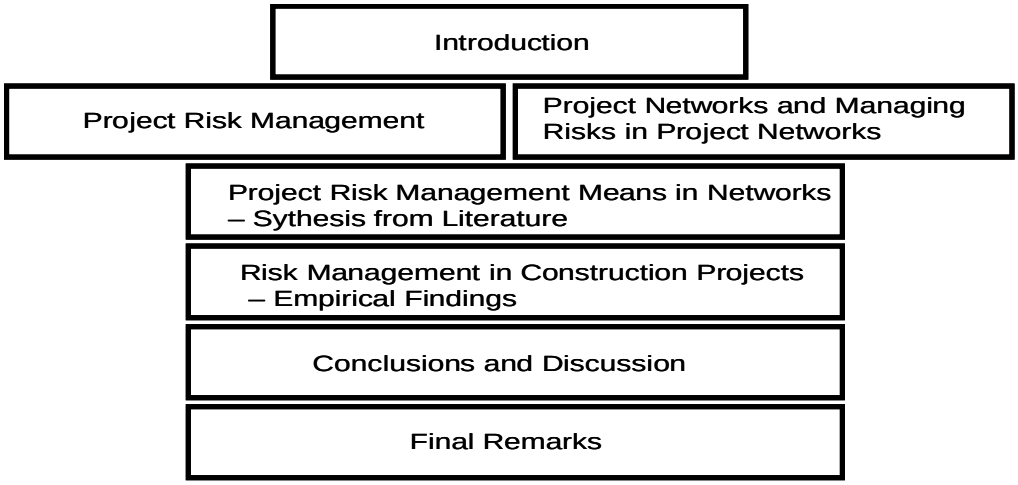


Figure 2: The structure of the study

[14] Jones, C., Hesterly, W.S., Borgatti, S.P., 1997

The study is divided into four main chapters; first, concepts of risk and risk management are discussed, based on literature sources and with the special characteristics of a construction viewpoint. Network governance is then analysed by using network theories. Network governance is also analysed by its usability and applications to construction projects. The literature part is concluded by highlighting the most relevant findings in this study's contexts, risks born by the network and means to manage them as presented in the literature. The fifth chapter consists of interviews of individuals associated with the two construction projects, the goal is to identify project risks that are caused by the network structure. Interviewees were asked to describe their means of risk management in the construction projects. Here, the emphasis is on co-operative means and how actors work together. The sixth chapter's objective is to combine results of both the empirical study and the literature review in order to identify the main findings and their relevance and implications to current risk management practices. Finally, last chapter points out the main research contributions.

2 Project Risk Management

Risk management is one of the most critical project management practices to ensure a project be successfully completed[15]. Royer[16] stated:

> *"Experience has shown that risk management must be of critical concern to project managers, as unmanaged or unmitigated risks are one of the primary causes of project failure."*

Risk management is thus in direct relation to the successful project completion. Project management literature describes a detailed and widely accepted risk management process, which is constructed basically from four iterative phases: risk identification, risk estimation, risk response planning and execution, often managing the risk management process is included. The first three phases are discussed later in this chapter, in section 2.2.

When dealing with risks, the potential for improvement should also be taken into account, for example to undertake the project with fewer resources or to take advantage of an unexpected window of opportunity. Risks are at the very core of the business: risks and opportunities are linked; there are no opportunities without risks related to them. Thus risks actually raise the value of a project; usually higher risks bring higher opportunities[17].

Since opportunities and threats are seldom independent, they can also be dealt with at the same time[18]. For example, many researchers prefer to use the word 'uncertainty' instead of 'risk', to stress the point that a risk has two sides, both negative and positive. The purpose of the risk management

[15] E.g. Turner, J.R. , 1999, Chapman, C., 1997

[16] Royer, P.S., 2000

[17] Miller, R., Lessard, D., 2001

[18] Chapman, C., Ward, S., 2002

process in a wider sense should not solely be to ensure a successful project completion but also to increase the expectations of project goals and objectives[19]. It means that project risk management should be turned into project uncertainty management[20]. The discussion between risk and uncertainty is further developed in the section 2.1.

Risk management is not limited to a few processes, but includes much more in order to have a complete view of the suggested risk management process. One of the most crucial decisions in a project relates to the allocation of risks: who carries which risks[21]. This is directly linked to this study; as it will examine how risks are mitigated and handled in project networks and which actors take responsibility for risk management. Before the decisions of risk allocations are ready to be made, the attitude that project actors have towards the risk has to be determined. Before a project starts, every actor's strategy, as well as the ability to bear and manage risks, has to be known before risks are assigned to them. Project risk management at the company level, which has to take into account all these afore mentioned factors is discussed in section 2.3.

This chapter will give an overview of the risk management processes, concentrating on new, emerging aspects. This chapter gives an answer to the first research question. Theory in this chapter is only shortly described and mainly accepted as it is presented in literature sources. Special attention is paid to construction projects and special applications to this industry are discussed separately in section 2.4.

[19] Mills, A., 2001

[20] Ward, S., Chapman, C., 2003

[21] Artto, K., Kähkönen, K. , Management of Uncertainty (yet unpublished)

2.1 Project Risk or Project Uncertainty?

Although risk is widely studied, it still lacks a clear and shared concept definition: risk is often only perceived as an unwanted, unfavourable consequence. Such a definition embodies two misleading concepts: first, among professionals there is an established consensus that risk needs to be viewed as having both negative and positive consequences. Second, risk is not only related to events, i.e. single points of action, but risk also relates to future project conditions. Conditions may turn out to be favourable or unfavourable. The point is that future project conditions are hard to predict in the early stages of the project life-cycle. In addition, conditions can change during the project life-cycle and the risk is that the conditions are different, and potentially more severe than was first estimated. Risks analyzed only as certain events are further criticised for not taking the degree of impact into consideration. Risks are seldom on-off-types, meaning that risks do not either happen or "not-happen", the impact of the risk varies greatly, depending on the conditions at the time of the possible occurrence.[22,23] Variability and the level of predictability (uncertainty) of the future scenarios determine the quality of risk analysis done today[24].

Therefore many researchers have suggested that the term risk should be replaced with a more neutral term that could embody a larger scope of than risk traditionally denotes. The term uncertainty is suggested to replace risk because it can easily embody the variability and ambiguity of risk.[25] The uncertainty still has a negative connotation both in English and in the Finnish translation epävarmuus. As such it does not perfectly fill the need for a term that should dissipate the negative or positive nuances.

[22] E.g. Kähkönen, K. in Artto, K., Kähkönen, K., Management of Uncertainty, unpublished

[23] Ward, S., Chapman, C., 2003

[24] Turner, J.R., 1999

[25] E.g. Ward, S., Chapman, C., 2003

Chapman and Ward[26] explain that uncertainty which matters is critical to all projects and that this uncertainty relates to more than just time and cost objectives of a project. An uncertainty includes for example problems like which parties ought to be involved, their motives and alignment of project objectives with corporate strategy. According to the authors, managing these uncertainties efficiently is a best practice in project risk management.

Same authors continued that risks are caused by a lack of certainty[27] and that uncertainty is especially prevalent in the early project phases. Since not all factors can be predicted at the onset of a project, yet decisions still have to be made, there is a risk that the outcome of these decisions is something other then what is expected. In this study risk is defined in a way that holds to in every sense of the term discussed above (section 1.4).

Risk has also other dimensions; many of them only recently introduced in the literature. For example Artto and Kähkönen[28] point out that risk also has the dimension of perception: to whom the risk is adverse or significant, to whom the risk is opportunity or less relevant factor. Risk perception is identified as one of the major improvement areas in the development of risk management practices. Kähkönen[29] suggests that the definition of risk could be localised in a way that it is defined more precisely in every specific case.

Based on these sources, it seems that in this study it is safe to use a word risk. If there is no single, clear definition for risk that is also missing from uncertainty. But these above mentioned perspectives help us to take a wider definition for risk. At the moment to develop a definition for and to think about dimensions of risk – and risks in a network – is seen most relevant in this study's perspective.

[26] Chapman, C., Ward, S., 2004

[27] Ward, S., Chapman, C., 2002

[28] Artto, K., Kähkönen, K. , Management of Uncertainty (yet unpublished)

[29] Kähkönen, K. in Artto, K., Kähkönen, K., Management of Uncertainty, unpublished

In the remaining part of this section, risks are categorized according to the various literature sources. Construction risk categorizations are introduced separately in section 2.1.2.

2.1.1 Project Risk Categorisations

Project risks can be categorised in a number of ways according to the level of detail or a selected viewpoint[30]. Some of these later presented categorisations are merely a risk lists, while some of these categorisations are formed based on the source of risk, by impact type or by project phase.

One of the most typical risk categorisations is presented in Table 2. This four-level categorisation is presented e.g. by Artto and Kähkönen[31]. This categorisation tries to fade a project type and be a general categorisation. Risks are divided into pure risks (e.g. hazards and weather conditions), financial risks (e.g. cash flow or credit risk), business risks (almost anything that can happen in a project) and political risks, which refer to the certain political environment and risks that are caused mostly by extreme conditions, such as, among others, war. Risks in the project network can relate to any one of this list's categories. Project actors can cause hazards to one and other because of inexperience, lateness of their products, delivery failure or unmade payments (bankruptcy) or new government laws either in favour or disfavour of the project.

Table 2: Typical risk categorisation

pure risks
financial risks
business risks
political/country risks

[30] Peltonen, T., Kiiras, J., 1998

[31] Artto, K., Kähkönen, K. , Management of Uncertainty (yet unpublished)

Turner[32] suggested that risks can be divided either according to their impact or by where the control lies. Thus these categories can be further divided into business risks, insurable risks, external risks and internal risks, for example bad weather is external risks since it can't be controlled by a project manager and business risks are those risks that in generally have to be accepted in order to have an opportunity to take advantage of positive outcomes of a risk.

Miller and Lessard[33] studied large engineering projects (for example constructing a new factory) and categorised risks according to their source (table 3). Market, completion and institutional risks are divided into three categories. Market risk is mainly caused by the demand uncertainty, completion risks refer to technical risks during and after the completion of a project (for example, will the capacity of a factory be as designed and planned). Institutional risks are related to the political uncertainties in a specific situation. They see that the whole project network should be utilised to manage risks, but their perspective is not that much co-operation than financially efficient risk allocation. They propose "a layering process" to systemically transfer, diversify and sell risks with financial instruments, real options and contract incentives.

Another division is made by Finnerty[34], whose book on project financing describes nine types of risk that are presented in table 4. This list is constructed from a project financing perspective, and corresponds with the construction-project specific risk categorisations (table 7). The reason for this similarity is probably that most project financing projects typically concern large engineering and construction projects. From these lists, it is harder to detect classes that would be sources for the risks caused by other actors or network dynamics.

[32] Turner, J.R., 1999

[33] Miller, R., Lessard, D., 2001

[34] Finnerty, J., 1996

Table 3: Risk categorisation according to Miller and Lessard

Market	Completion	Institutional
demand	technical	regulatory
financial	construction	social acceptibility
supply	operational	sovereign

Table 4: Risk categorisation according to Finnerty

supply
technological
completion
economic
financial
currency
political
environmental
force majeure

Categorisations help to form risk lists that are useful when identifying risks, but are inadequate when forming the whole picture. Obviously, many of the Finnerty's and Miller and Lessard's risks relate to the network structure; supply risks and political risks are the best examples of the risks that are caused by the other than the main contractor. Both of these lists are done from the main contractor's perspective, and are not that much concerning the optimisation of the whole network.

Aalto, Järvinen and Tuovinen[35] have studied risk continuums. They claim that traditionally risks are managed one by one and that the relationships between different risks do not receive adequate attention. This is relevant in this study too. While Aalto, Järvinen and Tuovinen suggest a tool to map all the risks and links between these risks, this study examines a co-operative means to manage risk. Study tries to take the whole project

[35] Aalto, P., Järvinen, P., Tuovinen, M, 2003

perspective into the risk management rather than just one actor's viewpoint at a time.

Risk continuums were also a concern of one case company manager, who emphasized the need for risk structure with cause-effect relationships while preliminary discussion about this topic were held. Also Chapman36 has taken the idea of risks having relationships, he concluded that their interrelations can be described and it does matter whether the risks are in a series or in parallel. This ads motivation to co-operate in order to manage risks, since one actor's false move, however minor, may cause a more serious damage to the actor working in the later project phase.

Earlier in this chapter the definition for risk was discussed, it was clear that seeing risk only as an event-type phenomenon is not sufficient, but the ambiguity and unpredictability related to the future conditions must also be considered. Many sources describe the uncertainty resulting from ambiguity, variability and lack of data. I concluded that in this study's perspective, risk and uncertainty are not that different that they should be separated as definitions. Ward and Chapman[37] have identified five different categories of uncertainty (table 5), which I next present; they are succeeded by the risk categorisations.

Table 5: Uncertainty categorisation according to Chapman and Ward

1. variability associated with estimates
2. uncertainty about the basis of estimates
3. uncertainty about design and logistics
4. uncertainty about objectives and priorities
5. uncertainty about fundamental relationships between project parties

[36] Chapman, R.J., 2001

[37] Ward, S., Chapman, C., 2003

From their list of five uncertainty (risk) areas, fifth is the most interesting in my point of view. Here authors have recognised that difficulty to identify responsibilities, capabilities and proper mechanisms for coordination and control is "a pervasive source of uncertainty". They add that these relationships may or may not include formal contracts. These are the core issues I'm interested in this study's context; what are these uncertainties in construction sites and what should be done to get these uncertainties (risks) managed?

Hallikas, Virolainen, and Tuominen[38] have presented a network risk categorisation, that divides risks in a network into four categories (table 6).

Table 6: Risks in the Network environment according to Hallikas, Virolainen and Tuominen

1	Demand related factors and value chain positioning
2	Delivery performance ability
3	Financial factors
4	Pricing

These risks are related to the external sources of risk, meaning that managing these risks means to manage or to cope with the project's external environment. This study focuses on the risks internal to the project, those risks that are due to the internal dynamics of the network. "Network risk" in Hallikas et al.'s study, as I understand it, refers to the risks that face operating a network outside the project. In my study risks in the network (or "Network risk") refer to the internal risk sources, things that cause risks from inside the operating network.

From the above can be seen that though many researchers have categorised risks, besides Hallikas et al's point of view network risks are not separated. Many of the earlier research is done from the focal firm's perspective and minimising the risk from that perspective. In the next section I continue

[38] Hallikas, J., Virolainen, V-M., Tuominen, M., 2002

this categorisation theme but now narrowing the scope to the construction project risks.

2.1.2 Typical Construction Project Risks and Uncertainties

Construction projects are characterized as very complex, always unique projects, where risks raise from a number of different sources. These projects are characterized by a continuous decision making due to numerous sources of risk and uncertainty, many of which are not under the direct control of project participants[39]. Construction projects have a bad reputation of failing to meet the deadlines and cost targets.[40] That's why identifying risk sources is extremely important, since it is not necessarily possible to identify single risks. Odeh and Battaineh[41] studied the most typical reasons for construction delays in Far-East construction projects. They found seven significant causes of delays: owner interference, inadequate contractor experience, financing and payments, labour productivity, slow decision making, improper planning and subcontractors. I've bolded all these since authors emphasize the meaning of experience and capability of project participants to have the most effect on these causes of delays. These kinds of risks can be seen as network-related. Thus in order to have a successful project, it should be guaranteed by some means that all participants are experienced and trained to do the project: it matters what kind of network is conducting the work. To improve the present situation, authors suggest different kinds of improvements to the contracts, incentives for good quality and awarding capabilities more than just the price.

[39] Baloi, D., Price, A.D.F., 2003

[40] Mills, A., 2001

[41] Odeh, A., M., Battaineh, H., T., 2002

Baloi and Price[42] concluded an extensive literature study on construction project risks in two different categorisation perspectives; a broad risk list (table 7) and an impact type list (table 8).

Table 7: Typical construction risk categorisation

technical	social
construction	economic
legal	financial
natural	commercial
logistics	political

Table 8: Construction risk categorisation by impact

dynamic vs static
corporate vs individual
internal vs external
positive vs negative
acceptable vs unacceptable
insurable vs non-insurable

Mills'[43] list of three of the most important risks in construction projects includes weather, productivity of labour and plant and quality of material. For example these areas are not easily controllable by a contractor before the project execution.

Cohen and Palmer[44] identified risk trends in construction projects. They found that typically, risks are determined at the very early phases of the project (feasibility and planning) while the impacts are not experienced until the construction and production start-up phases. Their list of typical sources for risks in construction projects is presented in table 9.

Table 9: Typical risk sources in construction projects according to Cohen and Palmer

[42] Baloi, D., Price, A.D.F., 2003

[43] Mills, A., 2001

[44] Cohen, M.W., Palmer, G.R., 2004

changes in project scope and requirements
design errors and omissions
inadequately defined roles and responsibilities
insufficient skilled staff
force majeure
new technology

Dubois and Gadde[45] found that complexity in construction projects comes from two basic sources; interdependence of tasks and uncertainty. Uncertainty has four sources: management is unfamiliar with local resources and local environment, lack of complete specifications for activities at the construction site, lack of uniformity of materials, work, and teams with regard to time and place and unpredictability of environment. Again, the bolded phrases indicate the sources with the highest relevance to this study. Dubois and Gadde's study's main conclusion was that the unstable and changing network is a major cause of the short-term sub-optimisation hampering a longer-term productivity, innovation and learning. To reduce this uncertainty, a firm should consider at least four different types of coordination inside the network and think relationships longer than just one project's perspective.

As can be seen from the risk lists and categorisations presented here, networks are the cause of risks to projects, both directly and indirectly. Indirect means that networks cause significant uncertainties that pose risks to projects. All the bolded items in the section above relate to networks as sources of risk. Risks that are caused by people in networks are social risks, they might also relate to personal chemistry. Other network actors are not totally in one actor's control: their behaviour is uncertain, local conditions and politics slowed decision making and uncertainty about other actors' capabilities cause risks to projects.

It is also very clear that these lists or categorisations are based on the assumption that risk is something negative and threatens the project. This sence is more prevalent in construction risk categorisations than in general

[45] Dubois, A., Gadde, L-E, 2001

project risk categorisations in the frequent use of terms such as “lack of “ ,“inefficiency”, and “errors”, among others. Opportunities in their part are rarely mentioned, thought it is obvious that without, for example business opportunities, business risks would not be worthwhile. However, to reflect on how these categories would change if risk perception was more neutral or even positive, is beyond the scope of this study.

2.2 Project Risk Management Processes

Risk management should be its own process in project management, but at the same time be closely tied in all project processes and phases[46]. There are several suggestions to improve the project risk management process, three popular process models are compared in table 10.

Table 10: Comparison of typical risk management processes[47]

Project Business	PMBok	APM
	risk management planning	define focus
identification	risk identification	identify structure ownership estimate
estimation	qualitative risk analysis quantitative risk analysis	evaluate
response planning	risk response planning	plan
risk management control	risk monitoring and control	manage

All of these processes basically have the same phases; only the level of detail in describing processes varies. All of them are meant to be iterative processes where risk management phases are kept ongoing during the whole project life-cycle. Iterative rounds are important, for example Floricel and Miller's[48] study showed that regardless of a thorough and careful identification phase, something unexpected occurred in every project they included in the study.

[46] Chapman, C., 1997

[47] Artto, K., Kujala, J., Martinsuo, M., 2005, PMBoK, 2000, APM Project Management Body of knowledge, http://www.apm.org.uk/documentLibrary/37.pdf

[48] Floricel, S., Miller, R., 2001

Risk management process should be implemented at the early project phases, when there is still a possibility for fundamental changes[49]. The project should be carefully analysed as to which kind of methods to use at which project phases and a process needs to be customised according to all project characteristics. The underlying reason for risk management is to ensure well-grounded and unbiased decision making[50].

Artto and Kähkönen[51] concluded various risk management processes generally to include three core processes, namely risk identification, risk estimation and risk response planning and execution. They also differentiate five accessory processes: risk management planning, risk communication, risk ownership development, risk management strategy and risk management control. Next, all identified core processes are discussed each in turn.

2.2.1 Risk Identification

The identification phase is stressed by many researchers52. It is quite obvious that if we are unaware of the risks, it's difficult to manage them, though this view is limited to the event-type scope of risk management. Section 2.1 presented the concept of risk from different perspectives, thus forcing on risks in a wider scope, moving from a single event-scope to wider uncertainty-scope. Chapman53 points out that since the risk management process builds heavily on the primary identification phase, the success of later risk management phases is directly comparable to the quality of the first identification phase.

[49] Chapman, C., 1997

[50] Artto, K., Kujala, J., Martinsuo, M., 2005

[51] Artto, K., Kähkönen, K. , Management of Uncertainty (yet unpublished)

[52] E.g. Chapman, C., 2001, Chapman, R.J., 2001, Turner, J.R., 1999

[53] Chapman, R.J., 2001

Skitmore and Lyons[54] conclusions contrast previous statements. Their study showed that risk management processes are applied the most in the execution phase, not in the conceptual phase. Still their study and usage of different risk management techniques showed that identification is the most frequently used risk management element. This proves that risk identification needs to be a continuous process and an efficient identification process requires many iterative rounds in even the later stages of project execution to successfully meet the expected targets.

Detailed steps and methods in identifying and catagorising risks are presented in many literature sources[55]. Methods generally include brainstorming, risk checklists, expert analysis/interviews, modelling and analyzing different scenarios and analysing project plans. Additionally, sources of risk or uncertainty and sources of known unknowns should be listed. Ward and Chapman[56] emphasise using an uncertainty perspective in the project risk identification phase, since they consider such an approach to be the best way to determine all possible sources of opportunities (positive risks), not just threats. These identification lists need to be followed and updated as our knowledge and understanding of the project environment increases.

2.2.2 Risk Estimation

After the risks have been identified, they must be evaluated in terms of the probability of occurrence and impact. An understanding of the possible effects on project objectives is needed: since most projects have only a limited amount of resources to use for risk management, concentration on only the major risks is essential[57]. Reliable estimates of likelihoods and consequences are needed for prioritisation.

[54] Skitmore, M., Lyons, T., 2004

[55] Artto, K., Kujala, J., Martinsuo, M., 2005, PMI PMBoK, 2000 and Turner, J.R., 1999

[56] Ward, S., Chapman, C., 2003

[57] Baccarini, D., Archer, R., 2001

Risks can be assessed either using a quantitative or qualitative analysis. The most common ways are to estimate risk probability and impact in simple scales for example, from 1 to 5 or from high to low, boundaries can also be numerically defined. In figure 3 a probability-impact grid is introduced, which is one typical and simple way to map risks. On the grid, risks that require the most attention are easily detectable. Lower left corner risks are noted, but actions to control them are taken only if there are sufficient resources or if mitigating the risk costs less than the product of possibility of risk's occurrence and its impact on project objectives (expected value).

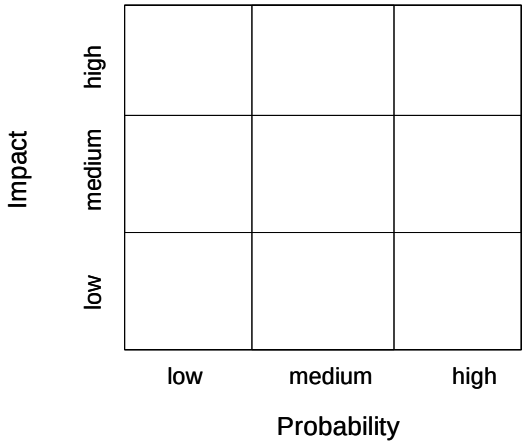


Figure 3: Probability-Impact Grid

Risk identification and evaluation does not provide enough support for the later risk management processes: the large amount of risk data from these two phases should be structured to aid in the interpretation and comprehension[58]. Risks also need to be assessed in relation to other risks, since these relations may cause minor risks to become more relevant to the risk management process if they are significant sources for other risks. A lack of attention toward cause-and-effect-chains was also a concern of Aalto, Järvinen and Tuovinen[59], when they initiated their research on risk

[58] Hillson, D., 2003

[59] Aalto, P., Järvinen, P., Tuovinen, M, 2003

continuums. Risk continuums are cause-and-effect-chains, where one event (risk) causes another to arise. Authors examined risks in four different levels of project business. In light of their results, managing risk continuums at all levels of project business is a fundamental step towards better and more efficient risk management.

Also Turner[60] suggests assessing risk links. Furthermore, he points out that this kind of risk analysis has to be limited to a relatively small number of single risks (e.g. 20 risks leads to 400 links to analyse). This limitation creates the danger that low-probability risks are left out, even if they were sources of more severe risks. Preventing these low-probability risks from happening might be less then the whole risk management process perspective.

2.2.3 Risk Response Planning and Execution

Risk response planning process is defined by PMBoK Guide61:

> *"..the process of developing options and determining actions to enhance opportunities and reduce threats to the project objectives."*

Literature[62] suggests there are generally four response types to cope with risk:

***Avoid**:* change in project plans in a way that an identified risk is no longer relevant.
***Transfer**:* transfer risks to other parties by contracts or insurances.
Mitigate: find ways to reduce the probability and/or impact of risk.
***Accept**:* take a conscious risk and deal with negative consequences as they occur, but take no action beforehand.

Planning of how to carry risks needs to have clear, shared principles in order to have a consistent attitude towards the risks[63]. The purpose of the

[60] Turner, J.R., 1999

[61] PMBoK, 2000

[62] Artto, K., Kujala, J., Martinsuo, M., 2005, PMI PMBoK, 2000 and Turner, J.R., 1999

[63] Artto, K., Kujala, J., Martinsuo, M., 2005

process is to ensure that actions that are planned and taken will have the expected effect on project risks, or if not, will effect whether new methods should be implemented.

Risk response planning and the execution- phase needs an effective control process by its side to ensure that the risk management processes are iterative and ongoing, are not dismissed as project starts and it follows that decisions are implemented and have the expected results. Monitoring and controlling usually means writing and checking documents and conducting meetings. Also Artto et al.[64] stress the importance of team work and communication as a means of risk management. Monitoring should also include evaluating the basis of earlier decisions, and assessing whether the assumptions made at the beginning are still relevant[65].

Saari[66] suggests a simple tool for monitoring the risk management process. She proposes using risk status as an indicator of the process phase under every recognized risk. Risk status describes the current situation of a certain risks. Table 11 describes the proposed definitions.

Table 11: Proposal for risk status definitions

identified
assessed
responses implemented
occurred
avoided

The risk management process described in this section is only a brief summary of the practices found in the vast written material that exists. It is included here to provide a basic understanding of the risk management process and to set the stage for the further analysis made in this paper.

[64] Artto, K., Kujala, J., Martinsuo, M., 2005

[65] PMBoK, 2000

[66] Saari, H-L., 2004

Suggestions or instructions how these risk management processes could be adapted to a project network, where multiple actors need to co-operate, were not found. As well, any specific risk management tools for project networks were not yet developed. V-M Virolainen[67] listed five important factors in managing risks in a project network: best practice, being prepared, recognition, follow-up and anticipation of the risk. How to achieve these factors is another question, for example best practices are not publicly documented anywhere.

2.3 Project Risk Management at the Company Level

Risk management at the company level has aspects that are not found at project level risk management. The main point is that a company has to have some kind of risk strategy to determine a common behaviour towards risks.

Floricel and Miller[68] developed five risk strategies for projects, intended for large-scale projects (e.g. construction projects) that described how risks in large-scale projects should be dealt with. They state that regardless of project-level strategies, a number of institutional anchoring elements must be put in place to tie project strategy to organizational strategy. It means that all organization's projects (called 'project portfolio') should be treated as stock portfolio. Also Ward and Chapman[69] promoted the corporate scale view on risks rather than just a project scale view. They introduced the concept of risk efficiency as a prerequisite of the holistic risk management process and formed a 'decision rule' for efficient risk management:

> *"Always minimize the expected cost of a project unless the risk implications at a corporate level are unacceptable, in which case the minimum expected*

[67] slides, Lappeenranta University of Technology

[68] Floricel, S., Miller, R., 2001

[69] Ward, S., Chapman, C., 2003

> *cost increase to yield an acceptable level of corporate risk should be sought."*

Authors point out that project level 'local optimality' may be in contrast with a 'global, company level' optimality. Project portfolio view, where all company's projects are managed in relation to others, is also convenient in risk management. If uncertainties and risks are seen as a portfolio and their interrelations and links to opportunities, then future potential gains could be better understood than they are at present.

Projects should be seen as a part of a bigger entity. Like an investor, a company might want to allocate its funds to projects with different levels of risk, so certain projects have higher risks, while other projects are allowed to bear only a limited amount of risk. It is important that risk management is not separated from the company's strategy. Risk management efforts and decisions should match the previously defined company risk profile[70]. Financial theory perspective is useful to explain some of the gains from project portfolio view.

Practical tools for making risk management at the company level include, for example, Baccarini and Archer's [71] suggestion that in addition to single risks in a project, whole projects could be assessed due to their level of riskiness. Projects could be prioritized according to their riskiness, for example using numerical scale from 1 to 5, where 5 is being generally unsure of the targets of cost, time and quality and 1 referring to a project with modest risks. Risk management efforts and assigned resources could be designed according to these categories.

Similarly than from a single corporate perspective, in a single large project, where multiple actors work on one site, risks are most efficiently managed if the risks are managed using a whole project perspective, not just from

[70] Artto, K. Kähkönen, K., Pitkänen, P.J., 2000

[71] Baccarini, D., Archer, R., 2001

every actor's own perspective. Projects where several actors are required to co-operate demonstrate how many dimensions need to be fitted together to ensure the successful completion of the project. Structures to fairly allocate risks and rewards among project actors in order to motivate the entire network to adopt a wider, whole project risk management perspective, is of extreme importance to successfully implement this new whole project perspective.

2.4 Literature View on Project Risk Management in Construction Industry

Typical construction project risks and risk figures of a construction project have been already discussed. Risks in construction projects are a significant element of the total project costs and thus their allocation has a major effect on project budget[72]. Construction projects are open systems, rather than closed systems, which adds to the variability and riskiness of the project[73]. The risk management process has to be adjusted to the co-operative environment in construction projects, but unfortunately this has not yet happened. Risk management in the construction industry still relies heavily on contracts, and the industry has the bad reputation of becoming involved in numerous disputes and claims. According to various studies, contractual structures are the main sources of the lack of flexibility and they have a significant negative effect on the actor relationships[74].

The first improvement effort in the construction industry is an attempt to promote the risk management process. Risk management should be implemented; contracting risks to other parties does not mean they are managed since nothing is done to deal with these risks, rather only the final cost of the contract is increased. Contract clauses are estimated to raise

[72] Zaghloul, R., Hartman, F., 2003

[73] Baloi, D., Price, A.D.F. , 2003

[74] e.g. Floricel, S., Miller, R., 2001

project costs by 8-20% of the total costs[75]. This supports and motivates efforts to find alternative methods in managing risks.

Apart from contracts, studies show that construction risks are mainly handled with experience, assumption and human judgment[76]. Since risks are highly situation-specific, expert judgment provides sufficient means of risk management. Problems occur when this expert knowledge isn't documented (which is common in the construction industry) and knowledge is not transferable. Other risks relate to possibly biased decision making, when personal background and assumptions inevitably reflect on the person's evaluation.

The usage of risk management techniques is varied in the construction industry. Brainstorming and team analysis for identifying risks are the most frequently used techniques, computer-aided methods are rarely used[77]. Often risk management is restricted only to the identification phase, events can be known in advance, but their extent is not quantified[78]. The biggest barriers in construction project risk management are a drive for cost effectiveness; risk management is seen only to consume resources and benefits are difficult to measure in financial terms. Lack of risk management resources and know-how restricts the use of risk management techniques. There are not enough capable personnel to conduct the risk management process and risk management is only in the heads of a few key people. Lack of an industry accepted model of risk analysis forces every construction company to form and test its own risk management models[79,80,81]. Also cultural issues such as negative attitudes and mistrust of

[75] Hartman, F.T., 2000
[76] Baloi, D., Price, A.D.F., 2003
[77] Skitmore, M., Lyons, T., 2004
[78] Mills, A., 2001
[79] Interview 21.6.2005
[80] Skitmore, M., Lyons, T., 2004
[81] Uher, T.E., Toakley, A.R., 1999

risk analysis, affects the results of the process[82]. Simply a lack of knowledge and communication causes risk management failures.

Construction projects face a significant amount of uncertainty that is not related only to the early phases of the project. Ford, Lander and Voyer[83] came to the conclusion that great project value remains hidden in the project, in positive risks (or uncertainty) that is not actively searched. Floricel and Miller[84] made a similar find that in large scale projects managers often try to secure favourable conditions for projects by identifying and pre-empting possible adverse effects by ignoring possibilities for positive ones.

Odeh and Battaineh[85] recommended the following improvements to construction risk management: incentives for early completion should be included in to the contracts and adopting a new approach to awarding experience instead of the lowest price. That way an experience would have the weight it seems to deserve. In a network viewpoint the financial allocation of risks is critical. Zaghloul and Hartman[86] said an adequate risk sharing system should be the kind that would give the benefits of risks not occurring in all parties. Floricel and Miller[87] suggested establishing shared financial safety reserves for mitigating crises when they happen.

[82] Uher, T.E., Toakley, A.R., 1999

[83] Ford, D.N., Lander, D.M., Voyer, J.J., 2002

[84] Floricel, S., Miller, R., 2001

[85] Odeh, A., M., Battaineh, H., T., 2002

[86] Zaghloul, R., Hartman, F., 2003

[87] Floricel, S., Miller, R., 2001

3 Project Networks and Managing Risks in Project Networks

Construction projects, as well as any other projects, are almost always including numerous different actors which makes studying project networks and network management relevant. Networks can also be within the core organization, but the focus of this study is on networks that contain different companies.

Taking a network viewpoint on construction projects has several advantages as summarized in Pryke's study[88]:

> *"[The network viewpoint]…enables to observe changing roles in a project, it moves away from hierarchical management structures and recognizes embedded relationships, also non-dyadic ones. And because all organizations are relational networks, the truthful picture would be a hard to get by just taking a single actor viewpoint."*

Pryke adds that actions in a network can be best explained by an actor's position in a network. So, when examining risk management in a network, it is necessary to consider the effects that the interdependencies between actors have. This study's purpose is to find out what risks network structure causes and how the network could be exploited to improve current risk management practices. Dyer and Singh[89] agree with Pryke:

> *"The relational view offers a useful theoretical lens trough which researchers can examine and explore value-creating linkages between organizations."*

[88] Pryke, S.D., 2004

[89] Dyer, J.H., Singh, H., 1998

Except studying how networks work, also to realise the value co-operation can offer is important. It has also been stated that co-operative relationships often emerge because of the need for the parties to reduce the uncertainty of the future by engaging in relationships[90], though social scientists explain that the fundamental reason for co-operation is the human need to create identity and inclusion[91].

This chapter presents further motivation for networks and explains the methods used in them. The emphasis on risk management and construction projects is not forgotten. First the basics of the network theory are presented. Secondly a motivation for using networks to aim for more efficient risk and construction project management is provided. The third section of this chapter further examines the concept of network governance: what is it and how it works. Lastly, a brief look at the transaction cost economics-theory that allows a more concrete perspective for the reasons and consequences of using relationships as a governance mechanism in business transactions.

3.1 Network Theory

Networks have been vastly studied and literature about the subject is extensive. This section presents theories from a few popular articles focusing on the main factors that are guiding the behaviour of an actor.

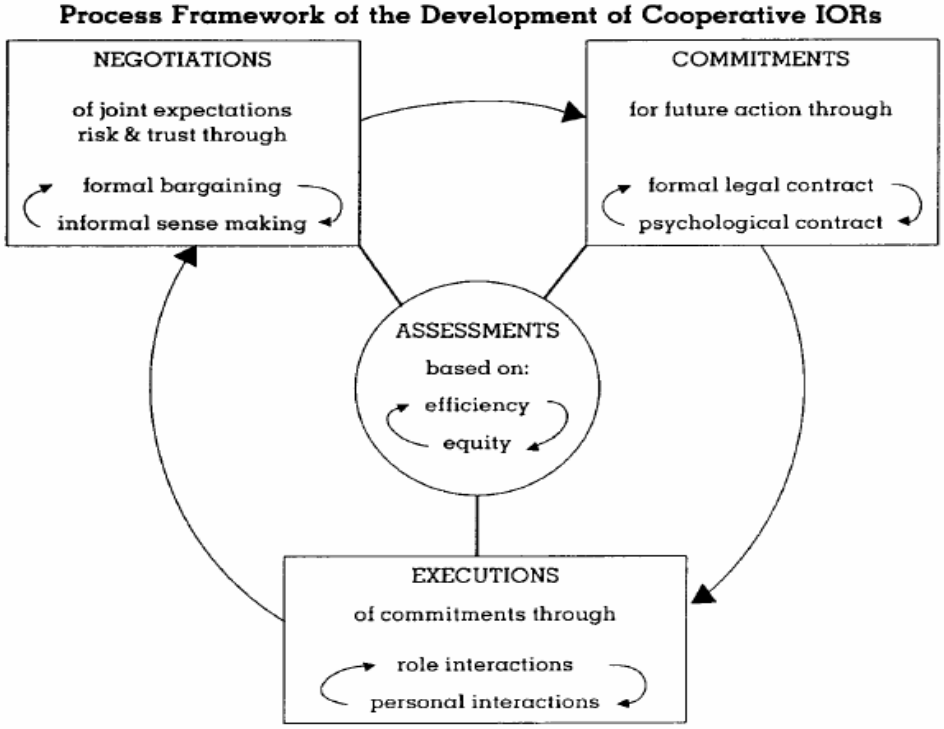
Easton[92] describes industrial network relationships as comprising four elements: mutual orientation, dependence, bonds and investments that each participant has made in every relationship. Bonds that link actors together vary, the researcher themselves lists different types of bonds to include at least technical, contractual and social ties as well as examples of logistical or administrative systems. A process framework for the development of co-

[90] Smith Ring, P., Van de Ven, A.H., 1994

[91] Smith Ring, P., Van de Ven, A.H., 1994, original source: Turner, J.H, 1987 Towards a sociological theory of motivation, American Sociological Review, Vol. 52, pp. 15-27

[92] Easton, G., 1994

operative interorganisational relationships (IORs) is presented in an article written by Smith Ring and Van de Ven[93]. It is shown in figure 4. It shows how formal and informal methods are linked and how important part that perceived risk and its distribution plays. While developing the framework, Smith Ring and Van de Ven argue that interpersonal ties are highly affected by the role an actor plays in an organisation. According to the authors, an individual's actions affects co-operation when an individual has to define the degree of uncertainty in exchange or to decide on the level of trust he or she can have on other party to resolve possible conflicts and when he or she is defining shared outcome expectations from the co-



operation. All these steps have a major effect on relationships and actors' actions in it.

[93] Smith Ring, P., Van de Ven, A.H., 1994

Figure 4: Development process of interorganisational relationship according to Smith Ring and Van de Ven[94]

In his popular article about embedded relationships in business networks Uzzi[95] stated that

> *"The findings suggest that embeddedness is a logic of exchange that promotes economies of time, integrative agreements, Pareto improvements in allocation efficiency and complex adaptation."*

Uzzi compared embedded ties with arm's length ties. Embedded ties are closer relationships that are based on long-term co-operation and trust. Embedded ties can be less frequent, but they are present in the most important exchanges. Transactions in arm's length ties are mainly governed by legal contracts, these transactions are less unique or otherways less important to the party and the need for adaptation is lower. These features make formal governance more efficient.

The three main components of embeddedness are trust, fine-grained information transfer and joint problem-solving arrangements. All these three components demand longer-term relationships, personal touch and mutually developed working methods, information channels and problem-solving practices. Embeddedness provides a competitive advantage for example in a form of economies of time and cost savings cause of less waste production. Embedded ties enhance risk taking since many parties together are capable of carrying bigger risks than alone. As well, embedded ties can simultaneously improve risk management enabling risks to be taken care of "on the fly", by just negotiating with "business friends". And thus reducing contract costs and saving time when formal disputes are avoided. But highly customised relationships carry risks other than

[94] Smith Ring, P., Van de Ven, A.H., 1994

[95] Uzzi, B., 1997

performance increases. Organisations whose business is purely based on their embedded ties are at risk, overembeddeness can cause firms to make excessively unselfish decisions that may restrict an actor's ability to detect the best partners or evaluate a possibility of others to misuse of the relationship (i.e. possibilities for opportunistic behaviour). Dyer and Singh[96] came to the conclusion that firms' capabilities in identifying potential partners varies significantly. Overembeddedness can cause limited competition and performance potential to fall. Uzzi stated that an optimal level of embeddedness can be found and that a network consists of both the embedded and arm's length ties.

In his study of networks Rowley[97] came to the conclusion that relational systems are often undervalued, though they are a fundamental aspect of business. He highlighted few points that should be taken into account in network studies. First, stakeholders also have direct relationships with one another: relationships can no longer be examined in a vacuum of dyadic ties, which has been popular in past research. Still, it is unlikely that all stakeholders have direct relationships with each other. Secondly, organisations are not necessarily at the centre of the stakeholder network and their position in a network clearly affects their behaviour.

Rowley[98] himself studied networks especially in terms of the density and centrality of the focal firm. Density is measured by comparing the existing ties in a network to a theoretical maximum number of ties. In a dense network, stakeholders are more powerful against the focal company. Centrality refers to an individual actor's position in a network, it is measured by the degree of relationships, closeness (ability to independently access other parties) and betweenness: how many other actors' relationships go trough the measured company. Centrality is especially powerful "tool" for focal company. This all means that firms can

[96] Dyer, J.H., Singh, H., 1998

[97] Rowley, T.J., 1997

[98] Rowley, T.J., 1997

no longer respond individually to an actor, and instead they must answer simultaneously to multiple parties.

Axelsson[99] discussed the meaning of power in a relationship. Power comes from rewards, it can be coercive, referent or legitimate, it can develop from expertise and informal sources. It gives an actor means to effect others by promoting, threading and persuading, power makes an actor's efforts more efficient. Axelsson defined the scope of power to be a set of activities one actor can get other actors to perform. Power that an actor has can be extended by increasing the number of actors in a network, but it has to be kept in mind that power does not come for free: it costs to use and maintain any given amount of power in a network and thus can be seen as an investment. Power is defined as the amount of control an actor has over (critical) resources and an actor's position in a network can be defined by the amount and the quality of power they have.

3.2 Why Co-Operation?

"Alliances are where the real growth is." [100]

This quotation provides reasoning for conducting business co-operatively: competing in business alone is not really an option anymore. The advantages of close relationships are numerous, in addition they are based on feelings such as trust that are extremely difficult to replicate and impossible to achieve in a short period of time. Relationships create the basis for competitive advantages. It encourages actors to make longer-term investments and to take higher risks. That way they can achieve higher levels of performance and greater success.[101] Actually, networking and advantages it can offer are possible only when actors are willing to make

[99] Axelsson, B., 1994, original source: Kutschker, M., 1985, The Multi-Organizational interaction approach to Industrial marketing, Journal of Business Research, Vol. 13 pp. 383-403

[100] Fenelle, C., 1996

[101] Daft, R., 2004

those longer, risky relationship-specific investments[102]. The risk of one actor overinvesting in the relationship still remains: the higher the level of trust and reliance on "old friends", the higher the risk and gains from opportunistic behaviour. Therefore formal agreements should follow informal ones. The real challenge is to form relationships that equally strengthen every actor's business.[103]

Smith Ring and Van de Ven[104] listed reasons for entering into business network relationships: access to new technologies, markets, scale economies, complementary skills and risk sharing all make network companies stronger together than alone. Dyer and Singh[105] claim that today firms' competitive advantage (critical resources) may even come from outside core organizations.

3.2.1 Why Co-Operate in Construction Projects?

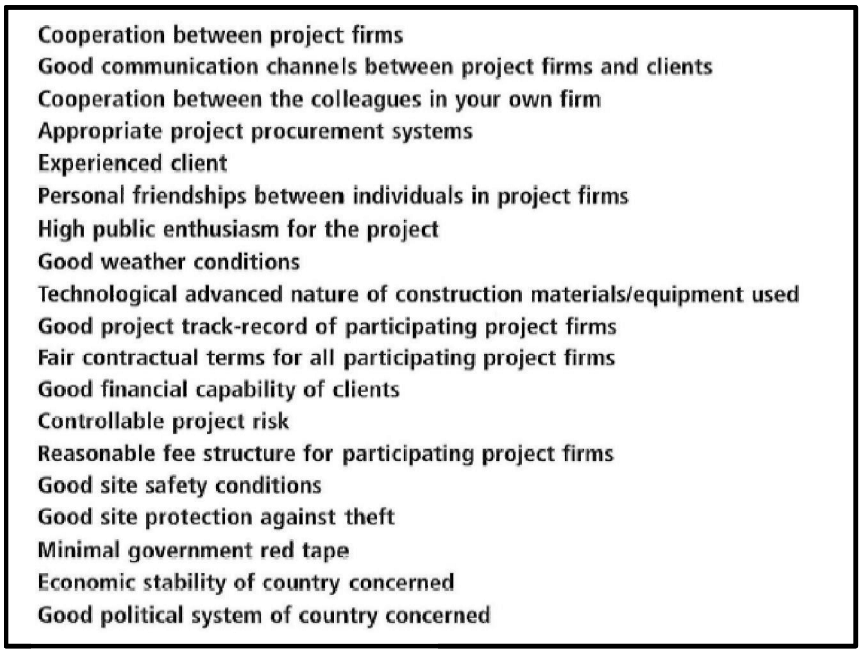
In a study of construction project success made by Phua and Rowlinson106 five major constructs of construction project success were identified: co-operation, micro project environment, contractual characteristics, site conditions and political and economic stability. From these, co-operation and contractual characteristics were the most significant, but their importance changed according to the type of actor. Table 12 presents the findings in more detail. The most interesting and relevant features in this study's context are personal friendships, communication and co-operation, although not the kind of co-operation, formal or informal, is not discussed in detail. The study proves that softer issues do matter significantly in project success.

[102] Dyer, J.H., Singh, H., 1998
[103] Smith Ring, P., Van de Ven, A.H., 1994
[104] Smith Ring, P., Van de Ven, A.H., 1994
[105] Dyer, J.H., Singh, H., 1998
[106] Phua, F.T.T., Rowlinson, S., 2004

Co-operation has been stated as a key to construction success, but detailed ways of performing it are missing. Construction projects are joint efforts of number of actors who need to work closely together. Changes in schedules, incomplete plans and other unexpected events lead to the need to coordinate daily work and efficient practical problem solving and on site management to ensure efficient performance. Contracts have been the main instrument used to share risks, though researchers think that in the construction business' exhaustive risk allocation can not be achieved solely through contractual conditions. It is common opinion that it is impossible to predict all possible events and even if it was the expense of including all of them in contracts would far exceed the benefits, since disclosure claims are very costly.

Table 12: Construction project success factors according to Phua and Rowlinson[107]

[107] Phua, F.T.T., Rowlinson, S., 2004



Floricel and Miller[108] suggested that a strategic system, structured processes to deal with risks, is the best way to cope with anticipated risks in large engineering projects. However, they admitted that strategising is not enough for coping with the high turbulence and uncertainty, which need to be controlled by careful planning and consideration of the entire business environment. That's why all project parties need to be conditioned, starting with their selection processes, by incorporating appropriate 'soft' or relational qualities as important selection criteria in order to ensure that co-operation and project proceeds "smoothly" [109].

In construction projects, project schedules can be very rigid and a single coordination mistake can affect everybody's work. Added to this is the fact that present day construction project schedules are as tight as possible, so that activities normally performed in sequence are now done in parallel,

[108] Floricel, S., Miller, R., 2001

[109] Rahman, M.M., Kumaraswamy, M.M., 2005

increasing actors' vulnerability to other actors' mistakes. This adds requirements for different kinds of coordination methods.[110]

3.2.2 Why to Co-Operate in Risk Management?

Co-operation and networking are especially useful for risk management, since the aim in project risk management should be to minimise the total cost of a project, not just a cost of a single actor. In the whole project perspective coordinating and integrating different parts is the most important task that is facilitated by close and efficient co-operation. In addition, all risk items cannot be foreseen at the planning stage and effective management of unforeseen risks in the post-contract stage needs the collective efforts of all major contracting parties[111]. Risk management is more flexible and successful when ownership coalition is used to bring innovative ways to deal with surprises[112].

Co-operation is needed in order for risk managers to have a comprehensive view of the wide range of risks[113]. Long-term relationships encourage longer-term commitment and more efficient risk sharing, trust-based relationships can help to avoid many disclaimer clauses leading to cost reductions[114].

Co-operation can also benefit a client by offering them at least a little control over other actors: for example subcontractors in construction projects should be selected in a similar way to main contractors[115]. In a way co-operation adds to the influence a client has on risk management. Main contractors can benefit from gaining local knowledge by co-operating with the local partners in foreign ground. Working together

[110] Dubois, A., Gadde, L-E, 2001
[111] Rahman, M.M., Kumaraswamy, M.M., 2005
[112] Floricel, S., Miller, R., 2001
[113] Fenelle, C., 1996
[114] Eriksson, P.E., 2003b
[115] Rahman, M.M., Kumaraswamy, M.M., 2005

creates similar working methods and practices amongst actors and coordination comes easier. Risks are already mitigated when shared working methods and common practices create accepted behavioural patterns which make actors' reactions more predictable[116]. The more predictable and certain the future is, less there is uncertainty benefiting all project actors.

3.3 Project Network Governance

> *"…network form of governance is a response to exchange conditions of asset specificity, demand uncertainty, task complexity and frequency. These exchange conditions drive firms towards structurally embedding their transactions…to use social mechanisms for coordinating and safeguarding exchanges."*

Jones, Hesterly and Borgatti's[117] definition of network governance written above explains network governance to be those informal mechanisms (social mechanisms) that are used to handle business transactions. Informal means enable actors to overcome exchange problems with less costs and greater flexibility. Exchange problems such as in Jones, Hesterly and Borgatti's definition, come from the fact that all business transactions become more and more customised, and companies are required to be able to respond quickly to changes which are more and more unpredictable. The problem is that in order to cope with these expectations, companies are forced to share information, and help others probably at their own expense. This is necessary in order to ensure their own survival in the network and streamline their operations to find a better fit with co-operative companies.

[116] Daft, R., 2004

[117] Jones, C., Hesterly, W.S., Borgatti, S.P., 1997

Network governance doesn't mean that actors are totally interdependent. Actors may be competing fiercely in some areas, but in a one selected network work as a single entity. Using hard bureaucratic means is just not time or cost efficient enough to keep up with the competition. Transaction cost economics are discussed further in the next section, but first we'll take a closer look at network governance.

3.3.1 Social Mechanisms to Govern Network

It was said that network governance is a set of social mechanisms. Definition doesn't define what these "social mechanisms" are. According to authors referred to earlier, exchange problems can be divided into two groups: coordination and safeguarding. These problems can be resolved with the social mechanisms; dynamics is presented in figure 5.

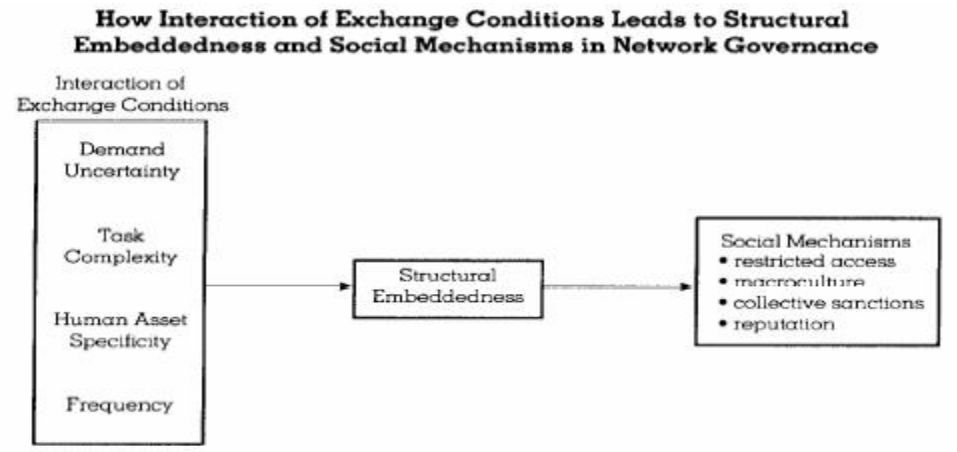


Figure 5: How social mechanisms are linked to exchange conditions, Jones, Hesterley, Borgatti[118]

According to these authors, exchange conditions determine whether the network governance emerges. They have recognised four main features that enforce managing transactions with social mechanisms. Four features are demand uncertainty, task complexity, human asset specificity and

[118] Jones, C., Hesterly, W.S., Borgatti, S.P., 1997

frequency of transactions. The more frequent, uncertain, complex or dependent on certain human assets the transaction is, the greater the advantages from and possibilities for network governance to emerge. In section 3.4 transaction cost economics is discussed in more detail and in section 3.5 its relationship to more effective transactions in construction projects are explained.

These mentioned exchange condition features encourage network actors to structurally embed (see section 3.1) their transactions. Structurally embedded transaction can be governed by social mechanisms. Social mechanisms help to dissuade an actor from working against common interests, which serves as a protection against outside competition. These methods can cause indirect financial loss to an actor who behaves in contrary to network rules. Restricted access to transactions in a network or network resources reduces the external actor's market. Collective sanctions have the same result as well as lost reputation. Such means of control comes from the rigidity of the network: gossip and rumours spread quickly if the net is very tight, restricted access is a more severe a threat if actors and their businesses are extensively interdependent. Likewise, the closer and tighter the network is, the better it is protected from outside competitors. A fourth mechanism, creating a macroculture -system where assumptions, values and behavioural patterns are shared, differs from the other three. Macroculture is not a punishment, quite the contrary, it is a reward that ensures stability to all involved actors and prevents behavioural exceptions. Macroculture makes the efficiency and gains from the network governance possible since formal governance can be streamlined from legal contracts to more trust-based methods.

Propositions from the Rowley's article[119] tie centrality and density into the picture. His statements support the point that network governance and its effects are in relation to the level of embeddedness in a network: "as

[119] Rowley, T.J., 1997

network density increases, the ability of a focal organisation's stakeholders to constrain the organisation's actions increases" and "as the focal organisation's centrality increases, its ability to resist stakeholder pressures increases". So the more embedded the network is, the more powerful a focal organisation is and that may help to lead the network into the one direction.

Nassimbeni[120] has collected various network studies together. According to him, construction projects are a kind of transactions that need highly integrated systems to deliver the outcome, since the end-product is a result of several smaller entities. He states that the most important interaction happens at the operating network; the most critical thing in construction projects is to coordinate independent actors, so that they would be well adapted to work towards a common goal. The main contractor should take the responsibility to coordinate and safeguard the transaction, direct supervision, standardisations and mutual adjustments are suggested means to coordinate construction project network He has somewhat more careful attitude towards co-operation in the network; since in his mind the greatest advantage of this network form, flexibility, is lost if actors are too dependent on each other.

Eriksson[121] suggested a slightly different kind of division for network governance mechanisms. Based on his literature review he simplifies governance mechanisms into three groups: price, authority and trust. In practice, all of these mechanisms or different combinations of them can be used simultaneously in one network, but some are more efficient than others in certain types of market and transaction situations. Basically, in an industry where markets rule, price is a traditional way of negotiating and handling transactions, authority representing the other extreme. Eriksson Erikssonclaimed that these kinds of controls are most efficient if the controlling party is not completely aware of the goal. It may destroy

[120] Nassimbeni, G., 1998

[121] Eriksson, P.E., 2003a

innovativeness and the motivation of other actors, and according to the author, a leading company, main contractor, should not try to achieve total control over its partners. Trust is a suitable governance form for hybrid networks, where both market and relational forces affect.

Eriksson[122] stated trust to be the most important governance form, since then the actors need not to protect themselves other ways from opportunism. Obviously great risks are related to this kind of network structure, but transaction costs are the lowest possible. Zaghloul and Hartman[123] have also stressed the meaning of trust: "in the absence of trust, the success of any project or business relationship is always questionable". Financial transaction costs increase if there is no trust, since it will create a significantly greater need for powerful control systems. Trust-based relationships lead stakeholders to mitigate risks to their own advantage, not to the disadvantage of others, as might happen in more competitive relationships where actors do not trust each other. Absence of trust adds to contractual complexity, leading to higher costs when contracts have to be written, disclaimer clauses and contracts also add to hidden costs by increasing the possibility of legal disputes.

Uzzi[124] claims that trust enables companies to complete exchanges that are hard to measure financially; these are extra efforts that are not formally controlled. They can, for example, help to cement "business-friend" relationships. Trust makes decision-making heuristic, not risk-based; it enhances a firm's ability to access critical resources, to opportunities and increases the flexibility of a network. These kind of real options are extremely hard to price, but undoubtedly they have concrete value.

[122] Eriksson, P.E., 2003a

[123] Zaghloul, R., Hartman, F., 2003

[124] Uzzi, B., 1997

3.3.2 Partnering

Partnering concept has been developing in resent years and it is still in its early stage. Many studies and empirical experiences are published, but researchers lack the solid understanding of when benefits from partnering are greater than investments to it, and how are the benefits exactly created by co-operation. At the moment, it is the most prevalent method of co-operative actions that can be found in the literature and thus it deserves a subchapter of its own.

The UK construction industry has been a major source of development for this new concept. The UK National Economic Development council defines partnering[125] as:

"a long term commitment between two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each of the participants"

There is not yet any consensus on what successful partnering consists of, but few features are introduced and quite commonly accepted. These features include mutually agreed objectives and goals, inter-organisational trust, mechanisms for problem resolution and continuous improvement efforts related to the benchmarking process.[126] From this study's perspective the most interesting parts are the mechanisms for problem resolution. Critical elements for successful partnering include long term commitment, communication and the early involvement of suppliers and the continuous evaluation of partnerships to ensure that objectives and expectations have been reached. Tying together learning and continuous improvement of the process helps to ensure greater benefits in the future. Tools to implement a successful partnering throughout the entire project include establishing integrated project teams, holding partnering

[125] Naoum, S., 2003, original source: National Economic Development Council, Partnering-contract without conflict, London: NEDO, HMSO, 1991

[126] Naoum, S., 2003

workshops and using dispute resolution planning and taking an innovative approach to the project.[127] Benefits should include a reduction in costs, construction time, defects and accidents and an increase in predictability, productivity and turnover. Still, it is recognised that it is too early to say whether the cost savings and other tangible benefits are as significant as claimed. As well, causal relations between factors and elements are not yet statistically proven.[128, 129]

Beach, Webster and Campbell[130] discussed the evaluation of partnering. They stated that especially amongst lower subcontracting levels the concept is somewhat unusual and difficult to grasp. They also wanted to differentiate dyadic long term strategic partnering from short term project partnering between several actors. Their results showed that clients were the main barriers in the adoption of partnering. Clients were not yet willing to take into account the best value if the price was higher. That led them to the conclusion that benefits are too unclear or unproven especially to clients. Results from successful partnering are waiting, since the idea is that the benefits come from continuous co-operation, lasting longer than single projects.

3.3.3 Relational Contracting

A relational contract is a method of governing continuing relations, a relational contract is often a longer term contract, but this is not necessary. In relational contracting, contract terms are not used and the focus is on how repeated interaction and social norms can ensure that obligations between parties can become self-enforceable. The theory of relational contracts focuses on the relationship between the contracting parties which ensures that opportunistic behaviour does not arise. The problem is that if

[127] Beach, R., Webster, M., Campbell, K.M., 2005

[128] Beach, R., Webster, M., Campbell, K.M., 2005

[129] Naoum, S., 2003

[130] Beach, R., Webster, M., Campbell, K.M., 2005

actors are not naturally co-operative, a method to ensure co-operation amongst them has to be developed. Relational contracting is still a fuzzy concept. Initiative must be self-enforced, occurring only among trusted partners. Only then it can be a substitute or a complement to the formal contract[131]. Table 13 presents the most important factors that are prerequisites for successful relational contracting.

Table 13: The importance of different items for a successful relational contracting[132]

rank	item
1	Mutual trust
2	Open communication among parties
3	Understanding each others objectives
4	Equitable and clear allocation of foreseeable and quantifiable risks
5	Attitude of the project participants
6	Readiness to compromise on unclear issues
7	Awareness of risks and rewards

All these are characteristics of successful partnering, or can be seen as prerequisites or enablers of network governance structures. It is clear that many risk management related things must be well taken care and developed together with the informal methods. Before this is possible, the environment must support these efforts (from table 13: mutual trust, attitude of project participants).

3.4 Transaction Cost Economics

Network governance is said to be an integration of transaction cost economics and social network theories[133]. Transaction cost theory is a means to compare relational governance issues in a more concrete manner. This chapter explains transaction costs and introduces the main points of

[131] Raynaud, E., 2002

[132] Rahman, M.M., Kumaraswamy, M.M., 2005

[133] Jones, C., Hesterly, W.S., Borgatti, S.P., 1997

this theory. Some of these benefits were previously mentioned, but are examined in this section specifically in relation to transaction costs.

Transaction costs are present in every business exchange (transaction). They are costs that are created when several actors are delivering the product instead of a single actor, or when the product is transferred to an other party. Costs are created when, for example, an actor has to monitor the completion of the product, while an other party is constructing it, but the costs of receiving an unwanted product would exceed the monitoring costs. Contracting costs and the adaptation costs created by different working methods are one of the most obvious sources of transaction costs. Transaction costs can be also information leaks, or can be caused by information asymmetries.[134]

Three dimensions of sources for transaction costs are asset specificity, uncertainty and frequency. Asset specificity and uncertainty lead to higher transaction costs as standardised methods to produce or "transfer" the product can't be created. Frequent transactions lower the costs by spreading some of them over several exchanges and making standardisation possible. The primary causes of transaction costs are irrational behaviour and opportunistic behaviour. Irrational behaviour is due to the fact that actors can not have all the information that is needed to form completely rational decisions. For example, in the risk management chapter (chapter 2) many authors emphasised the disadvantage of high uncertainty in a project environment, high uncertainty can lead to high information asymmetries and higher probability of misunderstandings and unintended results. The other source for transaction costs is the possibility for opportunistic behaviour, such as cheating, purposely misleading other actors, the failure to fulfil promises and the way in which contracts are

[134] Eriksson, 2003a

interpreted.[135] Transaction cost economics study how these costs are borne and how different governance mechanisms affect exchanges and costs.

Dyer's and Singh's study[136] of the determinants of interorganisational competitive advantage relied on reducing transaction costs in the network and relying more on relationships and trust as a governance means. The results are summarised in table 14.

Table 14: Determinants of interorganisational competitive advantage according to Dyer and Singh

relation-specific assets	duration of safeguards
	volume of interfirm transactions
knowledge-sharing routines	partner-specific absorptive capacity
	incentives to encourage transparency and discourage free riding
complementary resources and capabilities	ability to identify and evaluate potential complementarities
	role of organizational complementarities to access benefits of strategic resource complementarity
effective governance	ability to employ self-enforcement rather than third-party enforcement governance mechanisms
	ability to employ informal versus formal self-enforcement governance mechanisms

Competitive advantage increases as formal governance decreases. The network-level competitive advantage is created when knowledge-sharing routines and effective governance means listed in the table 14 are put in place. The value of networking increases and closer and more advantageous relationships can be developed, if duration and volume of the transactions are high and companies are capable of detecting partners with complementary resources. The study links project success to informal governance mechanisms.

Every business transaction needs to be coordinated, transactions have to be safeguarded and working methods adapted to the transaction companies. These three transaction problems inevitably involve major costs to all

[135] Williamson, O., 1998

[136] Dyer, J.H., Singh, H., 1998

parties. Network governance suggests social ties to ensure safe and efficient transactions. By reducing the costs of formal contracting, lowering the need for monitoring and contract rewrites as well as making the adaptation process less complex since all parties already are familiar with each others networking can result in significantly lower transaction costs.[137]

Instead of just reducing costs, informal governance can create benefits in closer, more trustful relationships that enable tacit knowledge transfer, sharing strategy and profit information that can enhance the optimisation of a network. Adapting to the shared working methods and behaviour towards other actors makes information transfer more efficient: the better is receiver's understanding of the sender's culture and of the knowledge received, the more readily a message will be understood. Thus networking decreases information asymmetry. A third "set" of benefits results from joint problem-solving arrangements that embedded ties entail. Mutual adjustment and routine negotiations are characteristics of this kind of behaviour enabling problem solving "on the fly".[138] It also enables dual-bases problem solving, both at professional and personal levels[139].

3.5 Choosing the "Right" Governance Means for Construction Projects

The choice of proper governance mechanisms for any industry is a difficult process. In construction industries cultural issues and cost efficiency are the main driving forces behind proper methods[140]. If the construction industry is so complex and different from other industries, it might be that management principles in other industries do not apply[141]. This chapter begins the discussion about the things that matter the most when

[137] Jones, C., Hesterly, W.S., Borgatti, S.P., 1997

[138] Uzzi, B., 1997

[139] Smith Ring, P., Van de Ven, A.H., 1994

[140] Eriksson, 2003a

[141] Dubois, A., Gadde, L-E, 2001

construction project governance mechanisms are chosen. Actually, it is clear that relational governance mechanisms can not be chosen. This chapter illustrates why certain governance structures are present in construction projects, these governance structures are explained in terms of construction business practices and transaction costs.

3.5.1 Transaction Cost Based Reasoning

Since governance forms are chosen to minimise and optimise transaction costs, the theory has a major effect on what are considered to be "the right" governance forms. The main governance form, or at least the most visible one, is an official contract. All contracts have problems; all complex contracts are unavoidably imperfect, in construction projects not all risks are foreseeable and actors will be confronted with the need to adapt to unanticipated situations that arise due to gaps, errors and omissions in the original contract[142]. Contracts decrease flexibility[143].

Smith Ring and Van de Ven[144] stated that it is never completely possible for the formal legal contract to mirror the informal understandings and commitments reached by the organisational agents at a point in time. Authors believe that legal contracts define the lower limits of the relationship, but that it is in the interest of both parties to seek more efficient ways of doing business, and a long term relationship slowly becomes specified in legal contracts as well. Disclaimer clauses add to the contract price with certain criteria, most important of which being business relationships, work conditions and contract type and fairness[145]. These statements link formal and informal governance types and also prove how costs can be controlled with relationships.

[142] Williamson, O., 2002

[143] Floricel, S., Miller, R., 2001

[144] Smith Ring, P., Van de Ven, A.H., 1994

[145] Zaghloul, R., Hartman, F., 2003

Williamson[146] said that the key factor in transaction costs is whether the transaction in question is supported by investments in transaction-specific assets. And such specialised investments may, for example, take the form of specialised physical assets, specialised human assets, site specificity or dedicated assets, all of which are characteristics applicable to construction projects.

Rahman and Kumaraswamy[147] listed construction project transaction costs arising from negotiations, writing contracts and monitoring performance; they are the costs of enforcing contractual promises. These means of risk management apply especially to the main contractor. Transaction costs are high in construction projects because actors do not learn from past experiences and mistakes are often repeated. Traditional adversial relationships make especially tacit knowledge transfer difficult and raise the transaction and contractual costs.[148] These are reasons to enhance co-operation.

3.5.2 Construction Industry's Business Practices Based Reasoning

Market-based competition has created for the construction industry business practices that are characterised by adversial relationships and large amounts of disputes and contractual claims. Clients are only interested in having the lowest possible offer and fear of loosing the bid makes parties bid below costs.[149] This inevitably hampers the long-term development of the industry and doesn't support a creation of long-term relationships. The business environment is a kind where price and authority are the main governance forms, though putting more emphasis on trust should be favourable[150].

[146] Williamson, O., 2002

[147] Rahman, M.M., Kumaraswamy, M.M., 2005

[148] Eriksson, 2003a

[149] Beach, R., Webster, M., Campbell, K.M., 2005

[150] Eriksson, 2003a

Construction networks are loose. Business practices, working methods and relationships within amongst actors in industry are so integrated that participation in a project is relatively straightforward. Main contractors have contractor pools where they select their subcontractors, but the price is important. Price can be negotiated if promises of other projects are made to the subcontractor. These conclusions are made by Dubois and Gadde[151] in their study of the Swedish construction industry.

Dubois and Gadde think that a loose system is a sensitive system and a more favourable network than tight one since there is more potential for variances and independent decisions. In addition, since the construction industry relies heavily on a strong community of practice (macroculture), informal governance mechanisms are born that way. It means that a network surrounded by one specific construction project necessarily doesn't need to be a long-term network in order to co-operation work fluently; actors share a macroculture that eases the co-operation even if actors would be new to each others. Only smaller level of adaptation is needed for guarantee flexible co-operation.

When governance forms are chosen, it should not thus be forgotten that the closest and most interdependent relationships are not always the best ones. The reason is that there are always both intended and unintended[152] consequences in peoples' actions and any informal control mechanisms can't prevent unintended actions. Some level of formal control is required. There are still clear signs that in the construction industry, the price and authority controls are not leading to the best possible results: adversial relationships destroy the benefits of a shared macroculture, hinder the long-

[151] Dubois, A., Gadde, L-E, 2001
[152] Williamson, O., 2002

term development of the industry and cause additional costs in the form of legal disputes and contract writing.

4 Project Risk Management Means in Networks – Synthesis from Literature

In this chapter I conclude my look at the literature. To begin with, I discuss what kind of risks the network structure causes based on literature study. In the second subchapter I divide risk management means that are most suitable for construction projects into three groups: 'Actor Specific' refers to those means where a single actor controls the risk. 'Dyadic relational' refers to those means that occur between two actors and means under the heading 'Network' are those that gather several actors together to manage risks. Groups were formed according to my perceptions of the literature that was previously summarised. The final part of this chapter builds a bridge from literature towards empirical part and provides reasons for empirical study.

4.1 Project Risks in Networks -the Literature View

Earlier risk management literature has not treated network structure and thus the risks caused by the network structure are not identified, at least not separately, in the literature. It is, however, acknowledged that factors such as co-operation, trust and relationships have a great influence on project completion and success. To name a few, owner interference, inadequate contractor experience, subcontractors, insufficient skilled staff, unfamiliarity with the local conditions, roles and responsibilities not clearly specified were among the categorisations that hindered the success of a project. These are clearly network related issues. In addition, it was noted that risks can cause other risks, even when there is a long time period between the events. Something that happens at the beginning of a project may severely threaten the project at later phases.

Other remarks that can be made when reading trough section 2.1 is that risks related to network structure are clearly more present in construction industry specific categorisations. This might mean that construction projects are extensively exposed to the risks caused by other actors. Studying the construction industry's business practices and working

methods as well as traditional relationships, supports the idea that actors in these projects are suffering from other actors' actions. Projects are often large, done in a complex network, where relationships are described as adversial.

I think it can easily be concluded that network structure does cause risks to projects. Means of managing them are already presented: network governance as I see it is a means of controlling and preventing undesired actions of one actor that may negatively influence other actors as well as means to encourage the positive results from co-operation. It will be interesting to see, based on the empirical study, whether actors in construction projects see other actors as threats to their own performance. After the literature insight about construction culture, it is difficult to imagine that actors would consider co-operating with others as an opportunity for improvement.

4.2 Governance Means for Project Risks in Networks

Risk management on construction sites is one of the most critical considerations that is made, so it seems strange that, according to many authors, theoretically constructed tools for construction site risk management are not as widely used as they could be. It also seems strange that the means that do exist only take into consideration the viewpoint of one actor. There is evidence that the responsibility of identifying and dealing with risk remains in the responsibility of the actor who carries the specific risk[153], yet there are many accounts of the standard complexity of construction projects due to the large number of parties that interact on site. Co-operation and close relationships have been stressed, but studies that emphasise the importance of these close relationships and co-operation don't address risk management. That's why I have selected to study network governance and how its principles can be applied to risk management. Next, I'll present the risk management means divided into

[153] Mills, A., 2001

three different groups that were formed based on the number of performing parties.

4.2.1 Actor Specific

There are numerous tools and methods that determine how an individual actor can manage its risks, but in this situation I'll concentrate only on the methods that are meant to control the risks that are caused by the network actors. An actor should first construct a risk strategy that serves as a method of reacting to risks or to avoid them.

The most common method of risk prevention in the construction industry is risk premiums. A certain amount of money is added to the contract price so that if risks materialise, there are financial reserves to cope with the situation. On site the supervision of subcontractors and employees is the main method used to ensure quality. Risk management is still largely dependent on experience and human judgement; technical methods are not used to a great extent. Planning ahead is also related to risk management at the network level; especially for main contractors co-ordination is the key to successful project. Planning work orders and making sure designs are correct and complete in order to enable suppliers to work without disturbances and thus increasing project performance levels.

4.2.2 Dyadic Relational

Contracts between two actors are the main risk management mean in construction projects. The term relational contracting refers to partnering-type agreements.

Trust between two parties is the essential starting point for all but contractual means of managing risks. So trust can be seen as a one governance mechanism: it prevents opportunistic behaviour. Since being trustworthy creates advantages to an actor, not to mention the disadvantages that breaking such an agreement could cause. But, for example, in a partnering process, trust is both a prerequisite and an

outcome[154]. Dyadic relations can be used to adapt their own processes to be congruent with others and to provide special services for "business friends".

4.2.3 Network

The simplest ways to manage risks in a network is to modify traditional risk management tools and perform them together. For example identification can be done in a group brainstorming session, and different actors risk lists can be brought together. Shared supervision, trust that everyone is striving towards the same goals; sharing information, creating even shared risk reserves; all these can be done co-operatively. By performing tasks together actors increase mutual trust and the combined experience of ten people is always better than only one.

Creating incentives so that they would serve as a motivation for all parties to work together to prevent negative outcomes for any network party. Allocating to and sharing risks with the parties that have the best abilities to manage them while keeping the authority to manage risks in a place will encourage actors to join risk management efforts.

Network relations offer actors incentives to behave according to shared principles. At first incentives can be such things as common working rules, later, if actors operate co-operatively, a macroculture can be created, which, among other benefits, makes it difficult for external actors to participate in the market. If the same actors work together for a long time, working habits emerge among the group and risks are prevented since common working methods prevent adaptation problems. Risks can also be managed as "friendship favours". In this case no official methods are needed. This lessens the costs and reduces the time and resources needed, for example, in making official claims.

[154] Beach, R., Webster, M., Campbell, K.M., 2005

Networks can pose other kinds of pressures as well: undesired behaviour can cause an actor to loose business, to be excluded from the network transactions, collective sanctions can be used to add to the impact of this punishment. A fear of loosing reputation and spreading gossips can function as a punishment, but may also provide motivation to improve performance and to achieve positive publicity within a network. These kinds of threats reduce the risk of opportunistic behaviour.

Partnering and relational contracting concepts are ways of using network governance forms and try to encourage informal methods of managing risks. Partnering is a useful way to manage subcontractors, not only to make effective quality, co-ordination and schedule management but also to prevent risks by choosing the most suitable subcontractors that are willing to make their own investments to gain a better reputation, a larger share of transactions or a more trustworthy image and it decreases the need for contracts and contractual clauses. These things should decrease the project costs.

A more formal method of controlling quality is to set standards. Standards can be put in place or agreed upon in processes, skills or products. Standards make it easy to assess whether a product, process or skill is of acceptable quality.

4.3 Conclusions

This literature review has given me an understanding of the factors that affect the behaviour and ideas as to how these behaviours affect successful project completion. It also provided me with an understanding of what the basis of co-operative risk management is, and how it could help to decrease transaction costs and make a project more profitable for all actors.

Construction industry is a very interesting industry both in terms of network governance and risk management. Theoretically a lot is gained from lower transaction costs since there are high levels of demand

uncertainty and products are highly customised, leaving parties more vulnerable to market changes. Relative task complexity further increases the need for coordination. Higher complexity and uniqueness leads to higher uncertainty of risk management, as is described in earlier sections. Higher uncertainty leads to higher transaction costs, which makes network governance structures useful in construction projects, since it optimises transaction costs in these kinds of projects[155]. Cultural issues are a matter of debate in the literature; some studies stress the meaning of trust[156] while others contented that adversial relationships are one of the most harmful factors to the development of the industry[157,158]. Uher and Toakley[159] explained how slow change rates result from the lack of knowledge and the lack of commitment to training, research and development.

The situation today seems to be that risk management is done mainly with the use of contracts. Relationships are used, for example a clear relationship between trust and the amount of disclaimer clauses exists; the closer the relationship, less disclaimer clauses are used in contracts[160]. Various risk management methods have been developed specifically for this industry, but none of them seems to have gained a commonly accepted state of the best practice[161,162].New methods such as partnering and relational contracting have been discussed in the literature, but the small quantity of practical experience makes the benefits of these methods somewhat questionable or at least untested. These things together have led researchers to the conclusion that methods are not used as efficiently or widely as they could be[163]. But it is also claimed that new contracting

[155] Eriksson, P.E., 2003a
[156] Smith Ring, P., Van de Ven, A.H., 1994
[157] Eriksson, 2003a
[158] Zaghloul, R., Hartman, F., 2003
[159] Uher, T.E., Toakley, A.R., 1999
[160] Zaghloul, R., Hartman, F., 2003
[161] Skitmore, M., Lyons, T., 2004
[162] Uher, T.E., Toakley, A.R., 1999
[163] Eriksson, 2003a

strategies (partnering, risk reward systems, alliances etc.) are not helping, that they are based on the self-interest of parties and adversial relationships still prohibit benefiting from these new contracting strategies[164].

Earlier in this chapter I summarised the literature by listing the governance forms that theoretically can be placed on a construction site and used as a means of managing risks. However, I was unable to find much empirical evidences for how these theories work in practice. Several questions remain: What is a ”joint risk management” or a ”joint problem solving” in practice? Various sources have introduced the necessity and benefits of co-operative, informal methods to manage risks in projects, especially in construction projects[165]. Are these methods as beneficial at improving construction project performance in practice as it would theoretically appear? This is proof that this kind of joint effort could already be practiced as a more or less unconscious behaviour. The following questions provide the basis for my empirical research. What are the concrete methods to manage risks in a network and how do different actors see risks in a network? What motivates actors to work together and what would help the relationships become less adversial? After I have described the present state of co-operative risk management I will analyse the possible inefficiencies and critical points for improvement.

[164] Zaghloul, R., Hartman, F., 2003

[165] Palaneeswaran, E., Kumaraswamy, M., Rahman, M., Ng, T., 2003

5 Risk Management in Construction Project Networks – Empirical Findings

In this chapter I present first how the study's empirical element was conducted and describe the data. Secondly, the main findings are presented, and divided into three subchapters. First, in section 5.2 identified network risks are presented. Section 5.3 describes means to manage risks in project networks and in the last section 5.4 interviewees' improvement suggestions are gathered.

5.1 Research Methodology and Data

The empirical data was gathered from two ongoing construction projects. The first was a public project that was about 75% finished at the time of the interviews. The other construction project was a private project, being almost complete when the interviews were conducted. Both of these projects were lead by main contractors, who are both large actors in their field. Halinen[166] suggests that when, for example conflict-handling is in the interest of the study to use a real-time approach to study the relationship. So, in this study I focused first on the issues that were critical at the time of the interview.

Altogether 14 semi-structured interviews were made, they were targeted at subcontractors, but also clients' and main contractors' representatives were interviewed. Figure 6 presents a typical construction project network and how these interviews were allocated between different actor groups. Links between different actor groups present the relationships. Here, the relationship refers to any kind of co-operation made during the duration project (legal contract, coordination tasks…). It can be noted that the focal actor is main contractor, others having connections to other actors do so mainly via the main contractor.

[166] Halinen, A, 1996

Nine interviews were related to the public project, while five to the private project. The biggest interviewee group was subcontractors' site managers or foremen, the other interviews were made by project managers from the main contractors' organisations and customer representatives. One designer and one material supplier were interviewed in order to get a more diverse perspective into the matter.

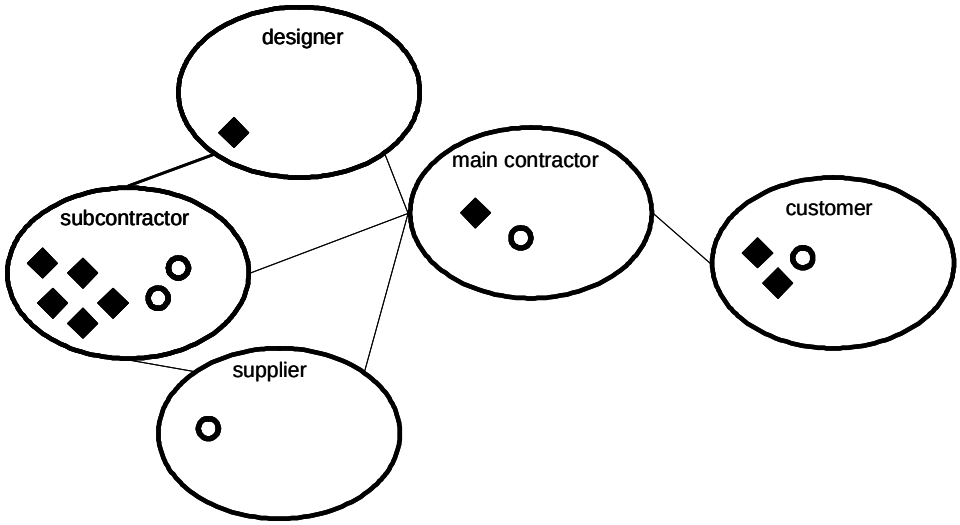


Figure 6: Typical construction project network[167] and allocation of interviews

Interviewees were encouraged to consider sources of uncertainty and risks, and especially focus on other actors as risk sources. Questions concerning the main risk management means used inside the company as well as on site were then asked. Also their opinions about the current risk management process and improvement suggestions were collected. A questionnaire is presented in appendix 1. All interviews were conducted in Finnish.

[167] adapted from Ventovuori, T., Kankainen, J., Pekkanen, J., Projektituotannon asiakkuus, Helsinki University of Technology Construction Economics and Management Publications 206, Espoo 2002 TKK-RTA-R206

When analysing the results, there seemed to be no reason to separate these two cases, the answers did not seem to have any relevant differences between the two projects. Another reason to treat the material as one group is the possibility that, due to the limited number of interviews, the respondents might be recognised.

Interviews were held either at the construction sites or at the interviewee's office. The place might have had some influence on the issues discussed, since at the construction site the difficulty was in finding a place where no other participants would occasionally be present. Interviews were recorded by making notes and writing them immediately after the interview was held. Recording responses during the interview was thought to cause overly cautious responses and for that reason it was not done.

Since the networks in these projects were relatively large, "network" in this study consists only of those actors that were interviewed. Here samples (networks) were formed and interviewees made decisions based on the information given by main contractors. Asking the interviewees from the main contractors causes problems since they might have their own interests. For example, main contractors might have been interested to hear one specific subcontractor's opinion. Main contractors might have also wanted to paint their projects in a positive light, and provide contact information only for those subcontractors that are performing well or the most loyal, or they may have just provided the contact information for the actor who was most convenient to ask.

Generally, interviewees were not eager to point other actors and all the interviews concentrated mainly on the individual's general experiences, further decreasing the value of possible case-specific analysis. One very important point is the definition for risk. Risk was not defined in the questionnaire, which in hindsight may have been a good idea in order to avoid the lost time that was spent explaining what was meant by the risk in this situation. Basically, respondents were not that familiar with the issues I was interested in about risks or risk management. This caused initial

confusion among many respondents, but for the most part they caught on quickly. A second significant point to take into account is a perceived risk – to whom is a certain risk is a risk – varies significantly depending on the actors' role and their situation in the network. One actors risk can, unfortunately, be another's opportunity. The personality of the interviewee also affected the responses and there were contradictory answers; some interviewees saw the same things very differently. However, the main message was in most cases quite clear and results follow the majority opinion. In this study's context I had no opportunity to analyse answers further in the light of perceived risk..

5.2 Identified Project Risks in Network

The first thing that came to light based on the interviews was a lack of understanding of the subject. Although risk management is very relevant and a "hot" issue in the construction business, for many of the interviewees risk processes and theoretical models were totally unknown. They had difficulties detecting or separating risk management from other activities. Additionally, the concept of risk can be understood in many different ways. I tried to avoid misunderstandings by defining risk in this study, but different interpretations of risk mainly based on jobs and responsibilities has at last some effect. Roughly speaking, main contractors were worried about schedule failures while subcontractors were worried about costs and clients about the quality.

In the following subchapters I present eleven network risks that were the most typical according to respondents. Since the respondent's mindset was based only on the negative side of risk, this list is built based on negative experiences. Still, these issues can also be opportunities, for example foreign workers may resolve the problem of ageing and diminishing labour market. The order in which these topics are presented is not meaningful. I want to emphasise that these results are generalisations based on all of the interviews, and may not be applicable to all actors but serve to create a more general picture of the situation. Structuring these

issues is difficult, since many of them are both causes or caused by other risks. Defining the "fundamental" or "primary" risks is difficult.

5.2.1 Lack of Risk Management Knowledge

A lack of risk management skills was one of the most visible deficiencies in risk management. Common risk management procedure was that risks were dealt with as they appeared. Even the representative of a main contractor said that if any new practices are developed they need to be fairly simple so that subcontractors are willing and able to do them. To main contractors this causes huge risks, and they had to accept responsibility for almost all the risks, since other actors were not necessary identifying risks, which is of course a risk to these subcontractors too. Main contractors worried since they had more of a "professional" and theoretical touch to risk management. But even they admitted that it was extremely difficult to identify risks caused by several actors.

On the other hand, many smaller companies also performed risk management processes but these actions were somewhat unconscious; subcontractors didn't call these risk management. Lack of formal risk management education meant that risks were not managed systemically. One might also question whether the existing risk management methods are flexible enough to fit with the dynamism of construction projects; from the literature review it was clear that industry-wide concept of risk management is still missing.

5.2.2 Lack of Risk Management Motivation

As well subcontractors did not recognise the risks or how they could have been mitigated beforehand, and they could not imagine any kind of threat that others could pose to them. This seemed to result from two things. Firstly, by thinking that their work was not related to the work of others in anyway in that they all thought that their particular part had little to do with other parts of the project. Secondly, others were not seen as risk sources, and as such it is not their problem. "After all, it's the main

contractor's business." These notions led to a lack in motivation for more collaborative risk management, since most of the interviewees did not see any benefits in such work. The same kind of attitude leads away from respecting the work of others, since it was perceived to be the business of the main contractor to take care of the whole project. This thinking led to damages in earlier completed tasks, even though they were most likely caused by accident. According to one interviewee these accidents may have been avoided with a more careful and co-operative attitude.

What it comes to the overall performance and uninterrupted work flow, actors admitted that these were major elements of every day work, but only few saw the related costs. This lack of motivation might also be a macrocultural issue, since "minding only your own business" seemed to be a main characteristic of the industry. This lack of motivation is also related to the lack of knowledge; as actors were very much unaware of risk management methods, it is clear that possible advantages systematic risk management can bring were unknown.

5.2.3 Lack of Experience and Professional Pride

Lack of experience can be a lack of risk management knowledge, but in this situation it also has another meaning: The talent and education of the respondents varied significantly. This has direct effect on the quality and productivity of the work. A lack of common education and the personal qualities which contribute greatly to the performance level, make it very difficult to evaluate the time spent on a certain task. It also makes it difficult to prepare beforehand for possible problems or for the amount of work needed for the guidance of crews.

The skills of the craftsmen, as well as the skills, abilities and personal character of the project manager had great influence on project success. According to the interviewees, risks, project team integration and a common atmosphere on site was related to the project manager, and that in extreme cases extra amounts were added to project tenders.

The overall environment in the current labour markets does not place enough value on trades. Other professions are more attractive to young people and not enough of them seek vocational education in the field of construction. During the recession in the 1990's, the construction industry's reputation was severely damaged due to the high rate of bankruptcies and unemployment.

5.2.4 Adversial Relationships

The reason for adversial relationships is caused by severe price competition. Traditionally adversial relationships make coordination and co-operation difficult. Competition has caused margins to diminish and additional rewards are sought. Interviewees admitted that, for example, due to the high degree of competition even the smallest changes in the work is fought for, contracts are read very carefully and there are cases where interpretations may differ considerably. This is not very fruitful ground to build co-operation, not to mention that it means extra investments on behalf of the actors.

Adversial relationships also restrict the sharing of experiences and information. Lessons learned in one project are not applied in other projects since interviewees thought that the relevance of a solution in one situation can not be repeated in another, since there was little chance that a comparable situation would present itself in the future.

5.2.5 Incomplete Designs

Incomplete designs are a widely recognised problem on construction sites. Everybody can understand the complexity and potential damage of how complicated a situation when, for example, an electrician must decide how to complete the work on a certain part of work at the site. Incomplete designs are one of the biggest reasons for the demand for co-ordination and co-operation. These are also situations where the professional capability of employees is measured; the solution has to be compatible with every job to be performed.

5.2.6 Information Flow Breaks

Information that does not flow trough the whole project organisation causes misunderstandings, delays and logistical problems. This was named many times as the most severe threat to the smooth completion of a project. It was recognised that since information does not move in the project network, it also does not go through a single actor's organisation. This was somewhat surprising to me since, as we can see in the section 5.3, several meetings are held during the project execution. Though, in light of previous findings of adversial relationships and a business practice that do not support co-operation, information delivery problems are not unexpected. Problems included people not always attending the right meetings, or those who did attend, failed to deliver the message to their respective organisations.

5.2.7 Foreign Workers

Opinions about foreign workers were divergent. All realised the problem that the construction industry in Finland will be facing a severe shortage of labour in a few years and foreign workers are necessary to fill this gap. Problems occur, when language skills are poor, professional qualifications unclear and quality viewpoints differ from Finnish ones. On the other hand, many respondents noted that most foreigners are extremely motivated and hard working. My point is that the risk is the investment that is needed to bring their skills to the level required professionally, linguistically and culturally.

5.2.8 Competition Based on the Lowest Bid

As a client, the public sector is especially difficult, since they are forced to take the lowest bid. There is no possibility of thinking about total costs, related, for example, to possible complexities in relationships or quality failures. That results in low motivation for extra work and small chances for development programs. Project networks become short-lived and long-term relationships are difficult to build. Severe competition over price

does not provide any concrete resources or motivation for long-term skills development or motivation to consider the interests of any other parties (or the network as a whole) than own.

5.2.9 Force Majeure

This is an aspect that never can be excluded from the construction projects. As one interviewee put it; it is impossible to build a whole house before the actual project has begun. Thus not all risks can be anticipated. An interesting point is that whether these seemingly "force majeure" risks really are "force majeures". Is it possible that they could be avoided, or at least renamed if some more systematic risk management means were used?

5.2.10 Extensive Subcontracting

Extensive subcontracting was seen as a problem. Reasons for this were not very clear. If all of the individuals on a site are from different companies than main contractors', "problems occurred". Interviewees were not able to give any concrete reason for the higher number of problems in construction sites where there are no employees of the main contractor.

5.2.11 Subcontractors' Subcontractors

Another risk involved in subcontracting is that one can never be completely sure who will actually perform the work; subcontractors may have subsequently contracted the job to someone else. In such cases, many of the aforementioned problems are magnified. For example an increased risk that information is not transmitted to all parties involved.

5.3 How Project Risks Were Managed in Construction Networks?

I previously listed ten risk sources that are present because actors need to interact with one another. In this section I use the same three groups to divide the risk management means as in section 4.2. Means of managing these network risks were not always understood as risk management, it was sometimes called quality management, but most of the time interviewees did not consider these processes as risk management. Risk management to them was related mainly to their company's business risks.

5.3.1 Actor Specific

'Actor Specific' group relates to those methods that a sole actor uses against the possible risks others could cause. From the interviews I was able to detect only one such method, supervision. The main contractors were the only ones to conducting supervision; they regularly visited to the construction sites to verify that everything was going as planned. Other actors were only concerned about their own work, and it was only if another party interrupted or hampered their own work that they paid any attention to the supervision of others. Even in this situation the practice was to go consult the project manager, and not other actors' representatives.

5.3.2 Dyadic Relational

'Dyadic relational' refers to the actions that are undertaken by two actors. In all cases dyadic relations situations involved a main contractor and a subcontractor. Main contractors add extra clauses to the contracts. Every actor has to sign an agreement that states they are willing to work according to the principals defined by the main contractor. These "way of working" contracts include, for example, quality standards, and mandatory meetings. Subcontractors thought that if they did not agree to these contracts, they would not be given the project. Main contractors' motivation for such contracts was the notion that, after signing, suppliers

can no longer proceed on their own terms, but must to agree to act according to certain principles. In their view they were trying to motivate subcontractors to care more about the project as a whole, not just their particular part.

Interviewees thought that their work in relation to others was largely dependent on the company's principles and traditions. Some companies had a principle to trust others, while some has a more polarised view.

Contracts were still defining the projects and they were the ultimate way to guide the project and actors. There were only dyadic contracts between a main contractor and subcontractors, or a main contractor and a client. For many, contracts were seen as a last resource concerning the direction of the project. All actors preferred meetings to contracts, and if they thought differently, others considered this irritating. One interviewee said that if they had to take the contract out, he felt they had failed in their discussions. One interviewee said that they always write a contract and refer to it, since otherwise there is a great risk that verbal agreements are forgotten.

Meetings are the main form of risk management. There were many kinds of meetings, between one actor and the main contractor, between one technical entity, between those who currently work at site etc. Regardless of the goal, these project meetings would be the right forums in which to bring up areas of contention. Subcontractors were reluctant to mention either their own problems or others failures "in public" so unpleasant issues were discussed only between two or three actors, the main contractor always being one of these parties.

Since personal skills were highly valued, reputation often governs an actor's behaviour. Both professional and social skills were considered relevant to project success. This is especially important in Finland where the industry is small and every one know everyone else. This means that word of mouth is an important aspect in the business, and mistakes are not

soon forgotten. Main contractors admitted that if they do not have previous experience with a particular company, they will call contact someone who has experience with that company before agreeing to accepting the offer. Subcontractors also used this approach when accepting jobs; it just happens that some sites are more hazardous than others. And subcontractors confessed that additional risk reserves are added to the offered price if a project manager is known to be unskilled or there is a lack of a personal relationship between the parties. On the other hand, if two actors knew and trusted on each other, it immediately reduced the need for formal contracts resulting in a "paper war" during the project. A prominent characteristic of both professional capabilities and social ties was that they were both extremely personal. Relationships were not firm-specific, but personal, as well as professional abilities "did not guarantee a Schumacher on every team".

Partnering efforts were made, but these were also one-to-one agreements, where main contractor tries create closer relationships with the most important subcontractors. These were quite new practices.

5.3.3 Network

In the 'network' group I present those methods that gather several actors together. Like in dyadic relational- group meetings were the most relevant. The main part of the meetings was held face to face with only one supplier at a time. A reason for this seemed to be that no one wanted to bring up concerns that were potently unpleasant in public forums. Also, by asking a large number of representatives to attend the same meeting, main contractors ran the risk that major players in the project would not attend. Subcontractors thought that large meetings with representatives of several were useless and a waste of time. However, these kinds of meetings were still held.

There were small signs of partnering in a "real" sense (all actors involved), but only a few interviewees had any experience of this. Even

they did not see any great advantage that could be provided by partnering, mainly because they saw that the required investment was not worth it, since things proceed well without partnering and the possibility that the same actors will work together on another project is quite small. The greatest advantage of partnering that was mentioned was the opportunity to meet the designers and architects so that they had a chance to discuss their ideas and improvement suggestions by allowing subcontractors to discuss their part of the project with the designers and architects.

One guide for the entire industry are quality standards. Quality standards are the basis of every piece of work produced. A couple of respondents pointed out that these standards need to be improved. The main reason was that every building has its own demands and standards do not take all of the necessary factors into account and are thus not always the best way to produce a product in every situation.

5.4 Improvement Suggestions from Interviewees

Interviewees did not have many improvement ideas. The general attitude was that risk management was already so much of a preoccupation that if more attention was paid to it, no other work would get done. Others thought that risk management could be improved by making actors more aware of the processes and methods. Learning from project to project was poor, interviewees admitted that even if they proposed a new solution and invested serious effort into its development transferring that knowledge to others would be difficult even within their own organisation, let alone to other actors involved in the organisation. Within organisations, such experiences were shared during coffee breaks.

One concrete idea was to develop a certificate as proof of professional skills. This would be especially useful when dealing with foreign craftsmen whose qualifications were often unknown. Main contractors wondered how to motivate subcontractors to see the complete picture and

"to use their own head". Motivations other then money have not yet been found.

Main contractors had a habit of doing satisfaction surveys with their clients, it was suggested that these could be done also a number of years after project completion when the quality and practicality would have been tested in practice. One project manager suggested that satisfaction surveys could be completed by subcontractors also.

5.5 Characteristics of the Finnish Construction Industry

An interesting question is which part of these empirical observations are due to the Finnish construction industry' business practices, relationships and market characteristics. In this chapter I briefly describe the image of the industry that I developed during these interviews.

First of all, the markets are relatively small, even in the Helsinki area, where most major projects are completed. In this region all actors know each other well and work practices are the same regardless of the site. It seems that people, in general, are aware of the role played by every actor, and each has accepted their present state.

Markets have traditionally been adversial, high competitive situation and diminishing margins have enhanced an atmosphere of hard bargaining. The industry has been specialised to project manager firms, who have less and less of their own people on sites and to subcontractors are doing smaller and smaller pieces. But this is known to be a world wide phenomenon, not just in Finland. Still, I would say that people generally trust each other and certain business practices have been developed. This includes negotiation and not giving anything away for free, but the actors do trust each other. In the past, personal relationships have been extremely important in securing contracts for construction projects. However much to the disappointment of many who are involved in the industry, it no longer rely on "gentleman's agreements", This is especially true of more

experienced individuals who expressed a willingness to help a friend and that there were people to whose business they gave priority.

In Finland it seems that the industry has been facing a lot of quality problems, and the reputation of the industry has been declining. Cost and time objectives are achieved, for example, by inviting subcontractors to the site before prerequisite tasks are completed. Interviewees said that main contractors use this method to force others to finish their tasks faster. The other problem is the lack of qualified people; young people are not choosing construction industry and an average age is increasing. This is partly due to the recession in early 1990's that wiped out a large number of the companies including large well established ones. Companies are trying to fill the labour shortage with foreign workers and there are increasing numbers of them. All of this has not been without problems, some of which were mentioned earlier.

I could imagine that this lack of qualified employees will improve the subcontractors' situation as well that of the main contractors who still have their own employees.

Working together is not common in the industry; actually people seemed to be very reluctant to interfere in "other's businesses". All interaction between different actors relied on the initiatives of the main contractors. It was main contractor's job to take care of the coordination and organization efforts, subcontractors did not want this work and main contractors doubted they could to take on any more responsibility. Other things that are possible are the relationships subcontractors might have to the project client. To main contractors, these relationships are an unwanted situation when the supplier calls the client directly, which is embarrassing for the main contractor. The main contractors wanted to have the power to control the whole network and no one seemed to be eager to change that. "The idea that suppliers would do something together is a strange one," was said more than once.

5.6 Conclusions

I collected and organised the risks based on the empirical material (figure 7). I detected three major reasons behind these risks; business practices, lack of know-how and pure risks. I would say that the majority of risks in two first groups could be avoided if proper actions are taken to improve business practices and to focus on developing a skilful workforce. The third group of pure risks might also be mitigated when know-how, skills and business practices are moved towards a more efficient risk management perspective. Of course, there is always a degree of uncertainty that cannot be detected.

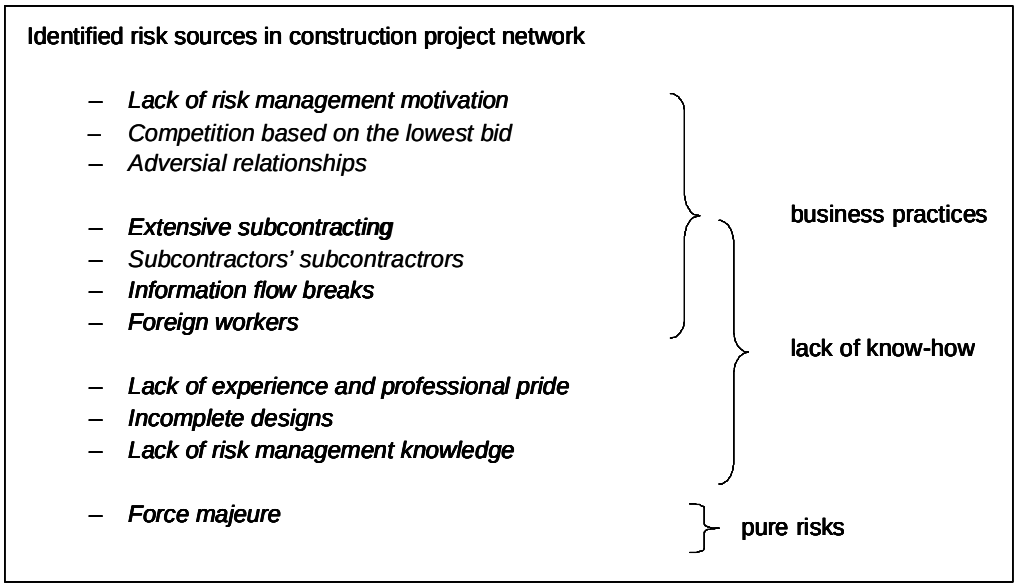


Figure 7: Identified risk sources in construction project network from interviews

Improper business practices cause project participants to compete fiercely and thus drift further away from the ideal of co-operation and the motivation to work for common goals. The whole project perspective is made unnecessary for project parties but the main contractors. This results from a trend towards focus and specialisation that has led to the extensive subcontracting and division of the project work. Adding to the lack of co-operation this that relationships are often adversial, all efforts to enhance

flexibility and wider responsibility of the whole project are almost impossible without significant changes in business practices.

Since the construction industry has suffered from a negative image, especially in the minds of young people, finding a competent workforce has become more and more difficult task. Actors in the industry are unaware of the modern risk management practices and the need to fill the gap between supply and demand for workers has lead to a situation where there are many foreign workers working on construction sites. While this is not a problem as such, problems occur when the educational background of these workers is unknown, or language barriers prevent the flow of information. Extensive subcontracting leaves main contractor unable to ensure the competency of the workers on the site. Pure lack of know-how causes risks to projects and makes efficient use and development of risk management difficult.

6 Conclusions and Discussion

Results show that complex networks do pose risks to its actors. As Hallikas et al.[168] stated, when the dependencies of companies increase, the more vulnerable companies become. However, their studies have concentrated on the risks that are external to the operating network, while I am focusing to the risks inside the project executing network and to the means how a network could improve its ability to manage these risks together. Section 6.1 lists and compares the risks related to the network structure based on interviews and literature findings. How these risks are related to the both project success factors and problems in project risk management is also discussed in this section.

The literature suggests that informal means to govern project networks might be more efficient than traditional ones concentrating on formal contract management and authority. At the moment these informal means are mostly unknown or rarely used in construction projects. Why the situation is like that is analysed in section 6.2, where I present the co-operative model for project risk management as a more efficient way to manage risks that are related to the network structure. Then in the section 6.3 the co-operative "ideal" model is compared with the existing situation based on the interviews and previous literature on construction projects. I will present the main challenges that according to my understanding hinder construction project participants from realising the benefits from closer co-operation. The suggested recommendations that would make these benefits more reachable to actors in construction industry are introduced.

The final two sections of this chapter discuss the reliability and validity of the research results and make suggestions for the future research.

[168] Hallikas, J., Karvonen, I., Pulkkinen, U., Virolainen, V-M., Tuominen, M., 2004

6.1 Construction Project Risks

I repeat the definition for risk used in this study (section 1.5):

> *"An uncertain event or condition that results from the network form of work, having an impact that contradicts expectations. An event is at least partially related to the other actors in a network."*

The literature has provided some hints as to these kinds of risks. In past research no one has listed risk under this theme, but according to the various sources uncertainty related to the network actors is one of the major risks in construction projects[169]. In table 15 I collected network related risks from typical construction project risk lists presented in section 2.2.

Table 15: Typical risk sources in construction projects

-changes in project scope and requirements
-design errors and omissions
-inadequately defined roles and responsibilities
-insufficient skilled staff
-subcontractors
-inadequate contractor experience
-uncertainty about the fundamental relationships between project participants
-new technology
-unfamiliarity with the local conditions
-force majeure

In figure 7 (section 5.6, p.88) I gathered the risk identified from the interviews together. In the next figure (figure 8) I divide these risks into four different groups (from group A to Group D). The division is made to

[169] e.g. Odeh, A., M., Battaineh, H., T., 2002, Chapman, C., Ward, S., 2002

better understand which factors cause these risks and to highlight the connection to the risk management practices.

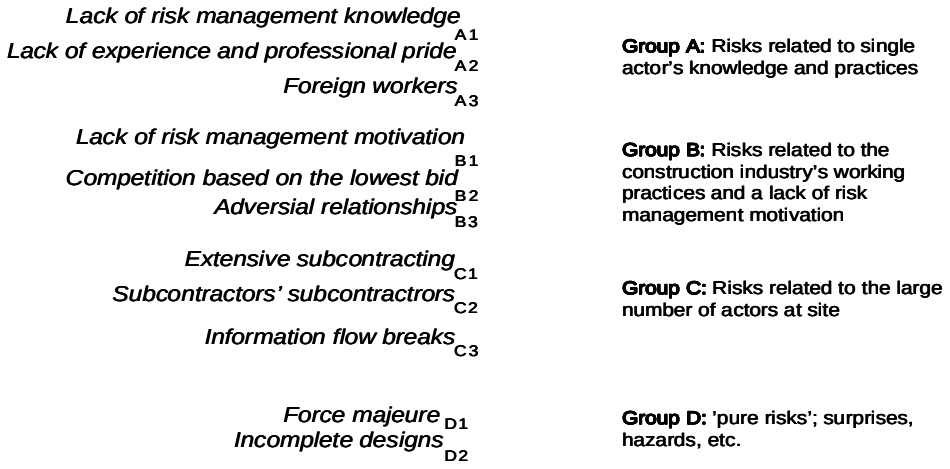


Figure 8: Identified risk sources divided in four groups according to the causes of risks

Identified risks were divided in these four groups according to the primary cause of the risk in question. Group A includes risks that are related to a single actor's knowledge, or in this case, lack of risk management knowledge and other risks that are caused because of one actor's practice of using for example foreign workers or unqualified workmen. Risks that are caused because of the construction industry's business culture and working practices are in the group B. These are high price competition and traditionally adversial relationships, lack of risk management motivation is also common to the whole industry, at least a motivation to co-operative risk management was non-existent except from main contractors side. Group C- risks are caused because of the many actors must work on one site. Information flow may be jeopardised, increasing with the number of subcontractors as many other coordination tasks become more challenging. In the last group (group D) belong the 'traditional' risks, risks that are surprises. These are the risks that can be managed with traditional risks management means, they are also easiest to identify as risks. These are the risks that are the most followed in the industry and at the moment the most risk management efforts are targeted to manage these risks.

If these two lists (table 15 and figure 7) are compared, it can be seen that many of my findings here are not new, but for the first time are presented collectively. For example a lack of experience, a lack of risk management knowledge and subcontracting has already been referred to as risk sources in previous studies. Empirical findings are in accordance with the earlier literature.

If detected construction project risks are compared with the project success factors presented by Phua and Rowlinson[170] (table 12, section 3.2.1), it is shown that factors very similar to those that aid in the success of a project success also impede its progress. The success of a project is limited if performance in these areas not sufficient. Success factors are, for example, good communication channels (compared to the information flow breaks named to be the one of the main risk sources), co-operation and personal friendships between project firms (compared to the adversial relationships of project participants in the current situation).

Many of these risks related to the network can be further characterised as conditions that jeopardise the project risk management process. These risks could be seen as continuums of management practices, where at the one end are the risks caused by the inefficient management practices or improper environment and at the other end the success factors that result from the good management practices and favourable conditions. For example extensive subcontracting and a large foreign workforce can be turned into opportunities that respond to the problem of an unskilled workforce and the lack of employees by using the right methods of management. These methods would be for example the kind that would guarantee the level of employees' competence. In the next subchapter I develop these ideas by presenting a co-operative model of risk management and how it is linked to the identified risks.

[170] Phua, F.T.T., Rowlinson, S., 2004

6.2 Co-Operative Risk Management

In this section I introduce my suggestion for risk management model in project networks. The purpose of the model is to enhance co-operation in a project network and lead towards more efficient risk management. Next, I'll present the model more in detail and how it relates to the identified risks in the project networks. In the final section I discuss more about the benefits it could provide to project risk management.

6.2.1 Co-Operative Risk Management Model

The model of co-operative risk management for construction project networks is presented in the figure 9. The model is not very detailed, since the risk management process and its methods need to be tailor-made and formulated according to the characteristics of the network (for example the power of the focal firm, risk management knowledge, embeddedness) and the project in question. Thus in this model, I present broader themes: that every project organisation should take into account, but detailed steps have to be identified in the context of a particular project environment. Floricel and Miller[171] have also supported this idea saying that achieving high project performance requires strategic systems that are both robust with respect to anticipated risks and governable in the face of disruptive events. So any risk management strategy has to provide a strong basis for the risk management process, but to be flexible enough to react to the environment where it is applied.

The co-operative model is formed based on the literature and interviews. It is divided into three parts: actor specific, dyadic relational and network groups, which refer to what every actor should do alone, together (with the main contractor) and together with the whole project network. In the figure 9 the number of people symbols refers to these earlier mentioned groups. So, starting from the top are the requirements for a single actor in the network; in the next eclipse with two co-workers are the means for

[171] Floricel, S., Miller, R., 2001

dyadic-relations risk management. In the last one with the small group of people are the suggestions for network-level co-operation and conditions that should be created to support this co-operation.

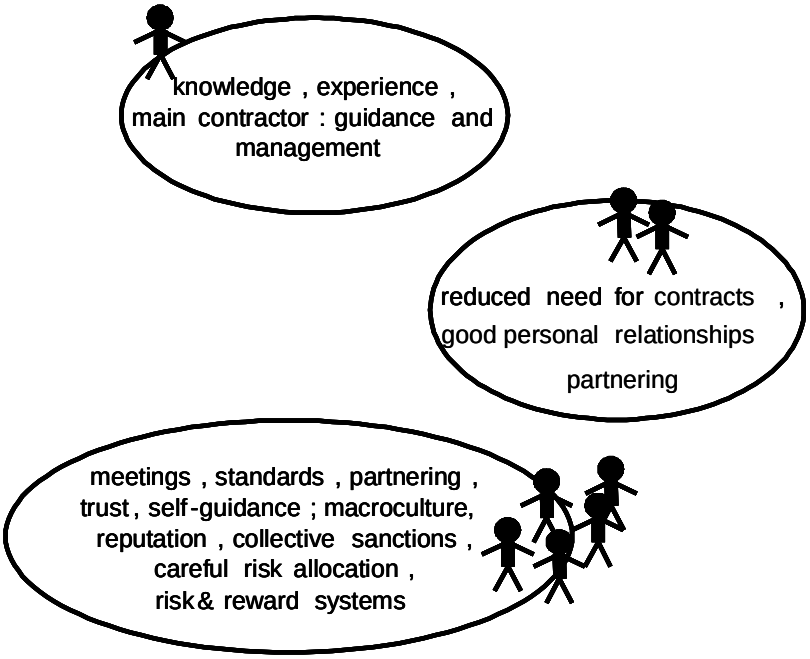


Figure 9: The model of co-operative risk management for construction project networks

As explained, the model follows earlier division of risk management means (sections 4.2 and 5.3) and is divided into three sections: it detects different governance means for three levels of project execution: individual, dyadic and whole project network level. It is not that much of a "guidebook" for how to effectively manage risks in project since detailed methods are mostly missing. It describes the state towards which actors should aspire, directing their attempts to reach this state. Like mentioned earlier, these practical methods and how to reach the optimum state for the risk management has to be determined separately in different kinds of project networks.

First of all, to fulfil the actor-specific requirements, every actor should ensure that they posses a good knowledge of risk management methods and practices, and the critical issues of their own task. Hallikas et al.[172] pointed out the importance and responsibility of every firm to identify, assess and know their own risks. Same authors suggest in their study that every company should first conduct a risk management process of their own, and that this process is made together at the points where interdependences cause risks to overlap with company boundaries. In my opinion this approach is not efficient enough for a construction-project environment, because of the need to centralise all actions and subcontractors' current lack of motivation and capability for risk management. Especially from the perspective of the main contractor, who in these projects carries the foremost risk, it is necessary for them to interfere with their subcontractors' risk management processes. The importance of this sort of central risk management can not be forgotten, since a need to integrate parts is one of the most relevant aspects of construction project management and the success of the execution phase depends on the quality of the coordination[173] and thus the ability of the main contractor to undertake this sort of management.

In dyadic risk management section of the co-operative model, risk management is based on the trust between actors and expensive special clauses and contractual risk management can be reduced or eliminated. At present, risk management is still done mainly based on contracts between two actors and for example for that reason much of the risk management is done only in dyadic relations. In the co-operative risk management model the importance of dyadic relationships fades and weight is put on the whole project network perspective. Partnering efforts are easiest to start in dyadic relations.

[172] Hallikas, J., Karvonen, I., Pulkkinen, U., Virolainen, V-M., Tuominen, M., 2004
[173] Salminen, J., 2005

The last set of risk management means is the biggest one, since risk management in the co-operative model is mainly based on the co-operation of the whole network. When the contracts do not guide the whole process, greater flexibility is obtained. Risk management at network level is done through negotiations, meetings and it is based on trust, mutual gains and optimal allocation of risk and optimal risk taking through out the whole project network. In order to achieve this kind of state or project environment, the network has to be strongly interdependent, all the actors have to be committed to the network "rules" and all parties need to share the same information, values, et cetera (macroculture). When a network is bound together by more embedded relationships, it starts to "produce" self-governing methods on its own. Opportunistic behaviour is prohibited by the social and economical threats of exclusion from the network if one acts contrary to the common interest. Furthermore, to ensure actors' dedication and willingness to work for the sake of the whole project requires that risks are shared throughout the whole project both social and fiscally. Shared risk and reward systems are set up to facilitate financial motivation. Introducing industry-wide standards can be the answer to the many problems, such as requiring diplomas to ensure that the skills of workers meet quality standards.

6.2.2 Co-Operative Model in Relation to Identified Risks

In the figure 10 I depict the co-operative risk management model presented in the earlier section in relation to the identified risks from the interviews. In the figure, the dotted lines connect a certain risk to the certain part of the co-operative risk management model. This is the part where the main responsibility to manage risk should be, but in some cases one risk can be related to two or all parts of the model. To make the explanation easier, I numbered every risk from A to D groups from 1 to 3 and parts of the co-operative risk management model are marked with Roman numerals.

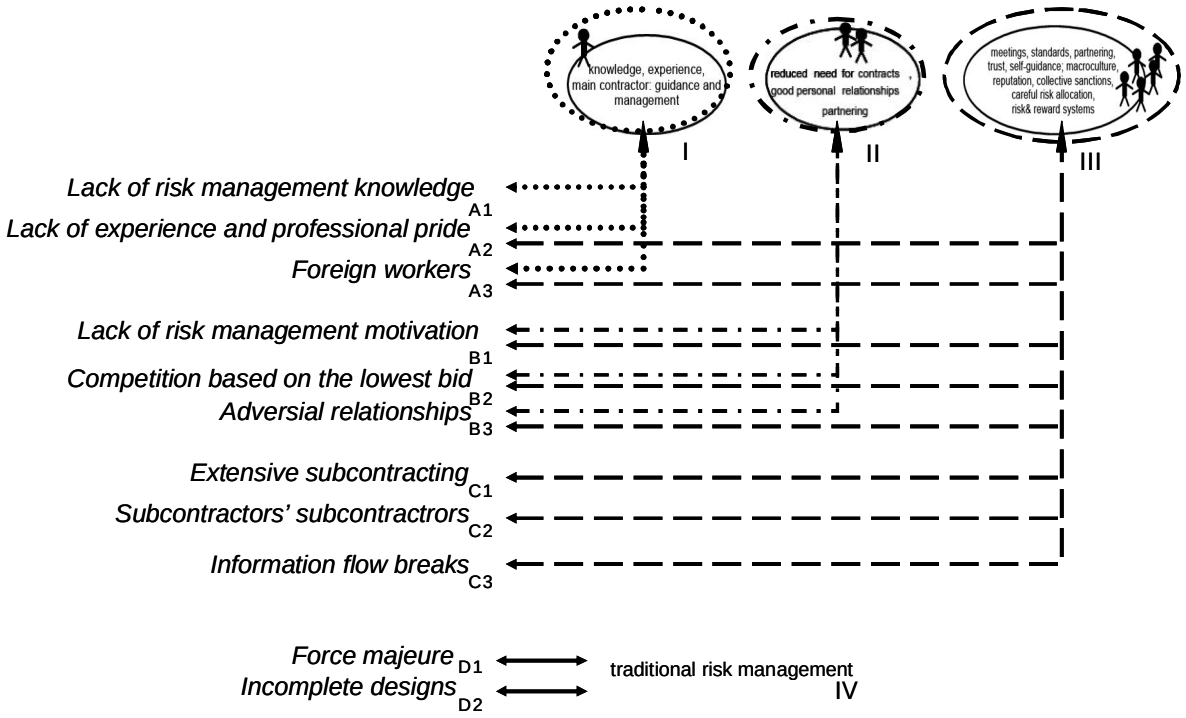


Figure 10: Suggested co-operative risk management model in relation to identified risks

According to my perception, the group A risks should be managed by a single actor. At first, every actor should be responsible for to ensure he has a proper knowledge of risk management methods (A1 à I), uses qualified and professional workmen, whether they were Finnish or from other countries (A2 & A3 à I). The methods to manage these risks are to hire only educated workmen, to organise professional and risk management training. Lack of experience and professional pride as well as increasing number of foreign workers are also related to larger problems of ageing industry practitioners and a relatively low image of construction industry as a vocation. These problems should be addressed by the whole network, methods at the first stage could be for example creating a skills quality standard, some kind of diploma that would guarantee a professional skills of an employee (A2 & A3 à III). This would make especially an evaluation of the foreign workers' abilities easier.

By having an understanding of the risk management methods and benefits, the motivation for risk management will follow. In the figure I draw an arrow from the lack of motivation both to dyadic-level risk management and network-level to indicate the need for shared risk management incentives that would serve as a real, financial motivation to participate and conduct risk management process. These incentives could be shared risk reserves or allocation of risks and rewards in a way that everybody gains if risks are mitigated (B1 à II & III).

Competing only with the price makes all development efforts difficult. Price competition has also a negative effect on relationships: when margins are squeezed, money is always debated and every small detail in the contract read with the highest attention, disagreements are common. If actors would engage in longer-term relationships with selected partners, that would hopefully reduce the contractual disputes, enable longer-term development programs and turn the relationships less adversial (B2 & B3 à II). The even more effective results are gained with several partners (B2 & B3 à III).

Problems related to subcontractors' subcontractors and extensive subcontracting are related to the coordination problems, the biggest maybe being information flow breaks. These can be best avoided if the whole network-level communication channels are efficient. Meetings, both formal and informal supervision make sure that information reaches the parties it is targeted to (C1 & C2 & C3 à III). Information will be further spread across the project network if actors are encouraged to join close and trusted relationships, then knowledge is transferred both officially and unofficially. Partnering agreements with many parties, creating opportunities to people to meet and get to each others better might help (project kick-off meetings, after-project parties...) (C3 à III).

The last group of risks are traditional risks. These are the most visible risks that currently are followed and the unquestionably large impact these risks when occurred have on project budget makes efforts to mitigate these

risks relevant. Force majeure risks are something that all parties both alone and together must take care of and be alert to recognise if anything unexpected is about to happen. Incomplete designs should also be in the responsibility of a designer and a receiver to check that designs are of the good quality. These risks are best managed with traditional, already developed, risk management methods (D1 & D2 à IV).

It could be noted that after the issues and risk are better managed and co-operation is working, many of these risks could become opportunities to improve and increase the performance in the construction projects. For example, the negative effect of incomplete designs might be mitigated if workforce was educated enough and working in co-operation to complete them on a site. The benefits from this kind of risk management will be discussed next.

6.2.3 Benefits Created by the Co-Operative Model

Benefits come in the form of the more efficient risk management that would be improved in this more flexible, trustful and professional (in risk management knowledge sense) project environment. Improvements would come for example in the form of shorter decision making, reduced transaction costs or better allocation of risks to the parties that can best take care of them.

Coordination problems will be mitigated if network governance means emerges. Network governance is not that much of a tool to select, but the state towards which a network could strive for to create a more supporting and motivating environment for co-operation and risk management. Practical means to create a motivation to co-operate with concrete, shared goals like shared financial risk reserves, shared supervision or many-party partnering agreements. When a network becomes more interdependent, relationships will be based on trust and common objectives that increase the willingness to co-operate and trust that the other party will do own share of work.

The power in this kind of risk management is based on the fact that when risks are managed together, the overall risk is reduced since risks can be allocated to the parties that can best deal with them. Since this kind of network is expensive to attain, partnering and other investments need to be done on a long-term basis. Long-term relationships need to be maintained to change the risk management processes in project networks from contract-led to relationship and self-governed-led. This model benefits the whole network leading to a reduction in transaction costs, when opportunistic behaviour is minimised and the entire operating network is striving towards common goals that is important for strategically, socially and financially. Transaction costs are further reduced when information asymmetries between companies are low because of trusting relationships and frequent contact ensures that information is distributed effectively. Stronger relationships and shared norms make working more efficient when common working practices can be formed and the behaviour of the network companies is easier to predict. The whole network is stronger when competing against the other networks that provide the same products since costs can be reduced and higher flexibility can be provided by the network.

6.3 Main Challenges in Implementing More Co-Operative Risk Management Process

In this section my goal is to connect the empirically found risks to the suggested model: how these risks could be mitigated if proper co-operative environment for risk management existed. Obviously, there are great barriers in the construction industry in order to this kind of co-operation and governance mechanisms to be effective. These issues are discussed in the next section (6.3.1). I detect problems that prohibit a closer co-operation especially in the construction industry. In the final part of this section I provide some recommendations how the construction industry could improve its practices and discuss about the three main challenges that the industry should first overcome. My discussion in this

section is based partly on the existing literature, while some is based on information gathered in the interviews.

6.3.1 Reasons for the Shortcomings of Risk Management Process

The first issue that emerges both in the literature and in the interviews is a lack of knowledge and motivation towards the risk management. Subcontractors had not adopted any formal methods to manage risks, they were managed as they appeared. These findings are in accordance to the Skitmore's and Lyon's research[174], where they find that construction projects do not use all of the existing risk management methods as efficiently as they could. There was no one explanation for this, instead the reasons cited were cost effectiveness, difficulty in seeing the benefits, human/organisational resistance, the lack of an accepted industry model for risk analysis, a lack of dedicated resources, a lack of expertise in the techniques, a lack of familiarity with the techniques, a lack of information and a lack of time. Other researchers have added issues such as negative attitudes and mistrust of the risk analysis effect on the results of the process to the causes of formal risk management process modest use[175]. All these reasons can be found in the interviews.

The network was strongly and centrally led by the main contractor. This seemed to be the most favorable practice in construction projects and all of the actors were in favor of keeping the situation as it is. Such a situation is hazardous to main contractors, who clearly face major challenges if any improvements to risk management are going to be done. At the moment, subcontractors felt their contracts were adequately protecting them from the risks posed by other actors and thus the interests in investing in the project co-operation were at best, modest. Since construction projects networks are so large and strong, management and organization is needed to hold everything together, it is natural that the risk management process is coordinated by one party as well, in this case the main contractor, who

[174] Skitmore, M., Lyons, T., 2004

[175] Uher, T.E., Toakley, A.R., 1999

is responsible for coordinating the project work and carrying or at least allocating most of the risks anyways. Since many of the problems that are caused by the lack of motivation or by risk management skills, main contractors have one more reason not to expect any major improvements on the part of the subcontractor. Contracts in construction projects are made in a way that does not motivate subcontractors to take part in the whole project's risk management processes. And thus the subcontractors' and main contractor's risk management processes needs to be made tighter in order to ensure its effectiveness or that some kind of risk management is conducted at all for the subcontractors' part.

Partnering, that is widely promoted for example in the UK, was not seen as important, since actors thought that the possibility of a similar project where such relationships can be used occurring again was relatively small. In addition, the relationships formed during the projects and partnering were considered to be personal, not for example company-level relationships. That makes partnering efforts harder to achieve and more expensive, if it is not enough to introduce companies, but the people to each other. Some early signs of partnering were only dyadic. A lack of risk management knowledge meant that the benefits of such a processes never materialised and thus the motivation to implement a shared risk management process was weak. Co-operation was seen only as an extra cost and when risk management development is not in the interest of the project owner, no one is willing to invest in it.

On the other hand, interviewees' answers to the questions about the benefits of partnering were somewhat contradicting: they said that it is quite useful to know others involved with the project, but then said that partnering efforts are not useful since people don't meet each others in different projects. I'm not able to provide clear explanation for this paradox. This might be in relation to the fact that actors that didn't know each other beforehand were anyway able to work together with all parties, since working methods and business practices do not change from project to project.

Maybe the biggest shortcoming is still related to the environment of the construction projects. Prerequisites for partnering and co-operation that were presented in the section 3.3.3 (table 13, p. 50) are not realised in the construction projects. As I see it, these are good advices to the successful co-operative project risk management. Based on the interviews, mutual trust, open communication, attitudes towards risk management, readiness to compromise and awareness of risks and rewards were at a very low level. When risks were, in the worst case unknown, the management and fair allocation of those risks is impossible.

Since the prerequisites and motivation for network governance means were not present, the project network didn't embrace any self-controlling actions and did not take advantage of more informal governance methods. The only thing was reputation that was seen as very important. In the small Finnish market, actors would know that if they had performed badly, every one would know quite quickly. Still, the consequences of this bad reputation were not clear, one threat was the loss of business, if main contractors did not trust them any more, but on the other hand having less trust-based relationship wasn't restricting access to the markets. Eriksson176 divided network governance methods into three groups: price, authority and trust. Now it seems that the construction industry is lacking in one area, trust-based governance means.

An unfavourable environment for co-operation lead to a risk management process that was largely performed in dyadic relationships, it did not matter the main contractors' tried to keep meetings with many parties at the same time, interviewees still held that "bad" issues were dealt with privately between a subcontractor and a main contractor. If subcontractors thought the issues dealt with in general meetings were not relevant to their job, they chose not to attend those meetings. The secrecy surrounding risk management forbade applying methods used in one projects to another project or the sharing of experiences between project partners. This is

[176] Eriksson, P.E., 2003a

extremely harmful on the whole network perspective, when tacit knowledge does not move inside the network. One reason for this reluctant attitude towards shared risk management process is interfaces between subprojects. Subprojects were seen as clearly independent of other subprojects and that other actors were not seen as posing any threat to their own subproject.

6.3.2 Main Challenges and Recommendations

In this section I discuss about the three main challenges faced in the construction sites that restrict implementing more co-operative risk management model and recommendations to improve the situation. Figure 9 concludes these recommendations and improvements gained while moving towards more co-operative risk management. Recommendations that are numbered and italicized are supported by many previously suggested actions from earlier studies[177,178,179,180]. Three main problems relate to the extreme price competition, lack of know-how and personality in relationships. Because of these, motivation to improve risk management practices into more proactive and co-operative, especially from subcontractors' side, is poor.

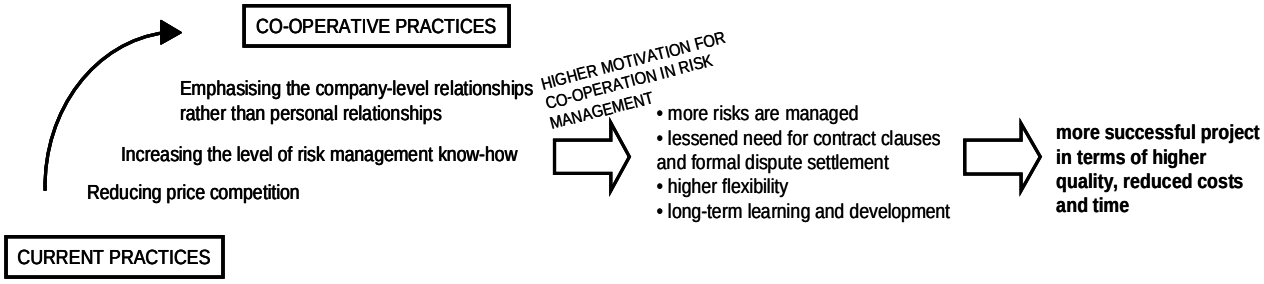


Figure 11: Drawing together the recommendations and a move to the co-operative practices

[177] Odeh, A., M., Battaineh, H., T., 2002

[178] Zaghloul, R., Hartman, F., 2003

[179] Floricel, S., Miller, R., 2001

[180] Artto, K., Kähkönen, K. , Management of Uncertainty (yet unpublished)

6.3.2.1 HOW COMPETING ONLY WITH THE PRICE COULD BE AVOIDED?

At the moment the construction projects are involved in heavy competition based only on price. This makes parties extremely reluctant – and unable - to invest any long-term development and learning. Relationships become adversial since one actors' loss is another's gain. In these situations clients are in the central position especially since public sector's clients should be able to put more weight on quality and total costs that are perhaps reduced by selecting a more expensive, but more reliable contractor for the job. Costs are reduced if a subcontractor does not cause any reasons for making formal complaints. The co-operative governance forms are not likely to prosper if actors are changing and the investments and risks that are taken (sharing information, trust and learning) are not providing any benefits if the lowest bidder is always selected. In the long-term, these investments might result in lower costs, higher quality and more flexible contracts and projects, which are also in the best interest of a client.

1. *The industry should adopt a new approach to awarding experience and quality instead of the lowest price. That would allow parties to invest into long-term development efforts.*

2. *Partnering efforts should be made, at first in large projects where the actors have worked together a long time, to enhance long-term relationships, learning form project to project and to provide possibilities for the emergence of self-governing systems would increase the efficiency of the co-operation and reduce costs.*

6.3.2.2 HOW THE LEVEL OF RISK MANAGEMENT KNOW-HOW COULD BE INCREASED?

In theory, many methods of carrying out risk management processes are presented, but they were not in practice used at sites. Few of the interviewed subcontractors were doing anything about risk management, and they admitted that they had little knowledge about risk management methods. The result is that risk management is too dependent on single actors. Professionalism and experience are extremely important in

identifying and managing risks, but only few are professional risk managers. Formal methods of communicating and of sharing experiences and knowledge were missing in both the network and company-levels. The construction industry in Finland will soon lose significant numbers of employees: if all their knowledge will leaves with them the industry and projects are in severely threatened. The huge wave of new risk management practices has caused many of the actors to be become oversaturated resulting in the rejection of all methods. That is why to recognise the most suitable actions is of a particular importance. Otherwise all actions are endangered and are incomplete.

3. *Risk management courses for all construction project parties to increase the level of knowledge of formal risk management processes and understanding its benefits would increase the willingness to invest in risk management and capabilities to do it.*

4. *Partnering efforts should be made, at first in large projects where the actors have worked together a long time, to enhance long-term, trustful relationships to share tacit knowledge.*

5. *Subproject inspection that is currently done once, should be repeated a few times during the project execution phase to reduce the dependency on personal qualities. Formalising best practices would encourage new people to join the project risk management and make their training easier.*

6. *International (e.g. Baltic Region) co-operation to launch skills certificates to make the evaluation of workers skills easier.*

6.3.2.3 How Personality in Relationships Could Be Turned into Company-level Relationships?

One of the biggest problems that construction projects face is that relationships are highly personal, not for example company-level relationships, but between individual actors. Professionalism and personal relationships, in some cases, affected the contract bid: if the project manager was known to be competent and the relationships they were involved in were good, the contract price could be reduced; the very opposite happened if parties did not have a good relationship and the project manager was considered less competent. Co-operation and investments to it were not seen that relevant, since the possibility to same actors to meet in the next project were low.

7. *Partnering efforts should be made, at first in large projects where the actors have worked together a long time, to enhance long-term relationships and would increase the possibilities for same actors meet in the next project and more formalised relationships to the company-level relationships in stead of personal.*

6.3.2.4 How Actors Could Be Motivated to More Proactive and Co-operative Behaviour?

In order to have a change in the risk management process, attitudes towards co-operation must turn significantly. All parties need to be motivated and understanding of the concrete benefits from acting in the best interest of the whole project. It is an extremely difficult task to make subcontractors more proactive towards the risks and to care about the whole project perspective. They lack the knowledge and oppose any extra work, but most of all, they do not see any reason to change current practices.

Clients are the ones who should think about their targets: whether to select the lowest price, lowest total price or to take part in the industry's development. Finally, clients are the ones that make the rules. Products are made for and bought by them and it is their needs that must be filled in a

way that best suits them. So, what is after all the best way to act in construction networks? The motivation for every business development should come from the benefits that are gained. Here, more efficient risk management should lead to lower costs. Ultimately it is costs that are the major issue in the construction business, since the industry is, as many believe, even over competed by price. Any changes to lower the costs should be welcomed, but at the moment, suppliers are unaware of risk management methods and do not see its potential for cost reductions. This lends credence to the idea that a centrally governed system is ideal. For example Nassimbeni[181] stated that the most important coordination mechanism for supply (e.g. construction) network is central coordination.

Means of network governance can not be expected to emerge as long as relationships are adversial and at arm's length. Some hints of closer relationships in construction project occurred because of business friendship favors and the resulting risks were taken "on the fly" within good relationships. Making networking possible especially when new employees, many of whom are foreign, adds challenges to this already difficult task. Their education and co-operation capabilities may be weak at the moment due to a lack of training and lack of a common language.

8. *Incentives for successful (whole) project completion should be bound in contracts.*

9. *An adequate risk sharing system where all actors share both the benefits and damages of all risks, for example shared financial safety reserves for mitigating crises when they happen would increase a motivation to care about the whole project.*

[181] Nassimbeni, G., 1998

6.4 Validity and Reliability

The reliability problem can be divided into two parts; one part is due to the Finnish construction industry's special characteristics and of how local business practices and relationships affect the interviewees' answers. The Finnish construction industry seems to be facing the same problems and issues as the construction industry in other countries, same relationships come to the surface whether the study has conducted in Hong Kong, the UK or Sweden. Although the empirical material is gathered from Finnish construction sites, I would see that results' applicability could be analysed in the international context, especially in countries where the business environment is similar.

The latter question is harder to answer as an outsider of this industry. I was left with the feeling that, since respondents said they were unwilling to take unpleasant risk related things to public forums, it might be that they are unwilling to inform a researcher of such things. In addition, this study was initiated by the main contractor companies, which may lead subcontractors to be careful of what they say, as no one was willing to risk their business reputation. To diminish this risk I decided not to electronically record the interviews since, in my mind, that would have had significant effect on the answers.

The reliability of the interviews is further questioned, because all of the interviewees were chosen by the main contractors, and interviews were held in part, at the main contractors' site offices. The other problem relates to the interviewees' understanding and definition of risk that varied. Most often risk was seen as their own company's financial risk, safety management or quality assurance. And risk was always negative. Suggestion to consider the risk as positive opportunity resulted in confusion and disbelief that anything could actually go better than planned. However, results and recommendations here are in line with the previous studies, which, in my opinion, provide a reason to expect that these results are reliable.

Generalisability as a whole depends on the fact that networks are always situation-specific, and every actor in a network sees the network differently. In project networks this is more apparent, since project participants are constantly changing from project to project. Still, though construction projects are unique form any other projects, the processes are not, I would say that since the industry's business practices and working methods are so commonly uniform, the behaviour of an actor does not depend on the surrounding actors, since all actors in the Finnish construction industry share the same working methods and business practices. Common working methods and business practices are well internalised that suggests the results could be generalised at least to the construction sector. Theoretically, applying network study results in the project environment is another thing to consider, since earlier network studies have focused on permanent networks, not temporary ones.

6.5 Suggestions for Future Research

As I have mentioned before, there exists an extensive literature from risk management and the network governance. Theoretical models, tools and techniques now need more practical examples and I'm curious about the possibilities of implementing these new co-operational management methods. In network theory, to study how project temporality affects the network governance research and the relationships and their evolution would be extremely important. Then to what extent different industries share business practices (macroculture) in a way that any actor can join the project without any significant implications to the network practices? Now it seems that at least in the construction industry a certain level macroculture exists.

In the risk management field, first of all, I would develop more concrete methods for co-operation. Since this study gives only conditions and state towards which to move, more practical tools are needed in order to make the co-operative risk management model process concrete.

Secondly, assessments of the concrete, financial benefits that co-operation can provide should be provided. I believe that financial gains will follow if more co-operative means are introduced, but that benefits are realised increasingly only in the long-term.

Thirdly, as many authors have emphasised, the real challenge is to form the kind of relationships and risk sharing methods that equally strengthen all parties[182]. How should risks and rewards be allocated to create a shared financial goal for all project actors?

[182] Smith Ring, P., Van de Ven, A.H., 1994, Hallikas, J., Karvonen, I., Pulkkinen, U., Virolainen, V-M., Tuominen, M., 2004

7 Final Remarks

As I started this study my goal was to find how ever more complex project networks cause risks to projects and how network could manage risks in co-operation. The idea was to combine risk management and network theories and to see how a network perspective could benefit project risk management and the overall success of the project. The construction industry was chosen as an example.

Already at the beginning of this study I was able to detect the vast number of studies on construction risks and their management. In this literature construction projects are described to be extremely risky projects, where uncertainty comes from many sources. During the literature study and the interviews, I was able to recognise several risks due to the network structure, many of them that in my opinion could be mitigated with the more co-operative risk management practices.

Earlier empirical findings suggest that despite the amount of risk management methods especially developed for construction industry, they are not in use at construction sites. Construction project risks are mainly managed with the formal contracts and the number of disputes is great. In the construction project it is inevitable that situations evolve over time: it is impossible in written contracts to edify complex and long-term projects, that's why more flexible governance means are needed in order to reduce risk for all project actors. Demand for more flexible and co-operative risk management means is recognised. Many researchers and practitioners have tried to find alternative ways to solve these problems, for example partnering concept is meant to ease informal co-operation and flexibility as well as longer-term relationships inside the industry, but these new contracting strategies (partnering, risk reward systems, alliances etc.) are not helping enough, they are based on the self-interest of parties and the adversial relationships are still there.

Often more flexible business practices would mean a rise in informal governance forms to more visible position. In the theory section I

reviewed understanding of how these mechanisms work and what motivates people to act even to their own disadvantage to the advantage of the network. Network governance mechanics in a way create themselves; they result in shared working methods and behavioural patterns, when an industry-wide macroculture is born. Methods are often the same ones that people use in their personal life: if some one betrays you, you'll loose your trust in them and no longer want to associate with that person. In the same way, acting opportunistically against common rules results in the exclusion of that actor from the network transactions and resources. By definition, network governance should emerge, when projects face assets specificity, frequent transactions, but uncertain demand and complex tasks. Thus theoretically, the construction industry should gain a lot if they systemically co-operated to reduce transaction costs and created more efficient risk management. The real question is why are these methods not adopted on construction sites? Despite researches, models and even successful examples, that emphasise risk management and co-operation, the construction industry seems unwilling to change its habits. Risk management methods are not used in practise as widely as they theoretically could be and co-operation is missing.

Based on the understanding gained during this research I formulated a co-operative risk management model. The main idea is to switch the risk management from individual or dyadic practices to network-level, where multiple actors would manage risks together. The model is not that much of a practical tool, but more of a guide to the better environment for risk management resulting in more efficient risk management and more successful projects.

According to my findings a co-operative risk management should have several advantages compared to individuals' efforts. Co-operation would bring more risks to the risk management process and it would reveal problems earlier and make a whole project network more proactive instead of a reactive attitude, where risk are handled when they occur. Co-operation and investment in the relationships between all actors might

smooth the interfaces facilitate the change. These developments would result in a reduced waste of time, a lessened need for contracts and diminished costs in writing and adding clauses as well as lesser need on behalf of the actors to add risk premiums to the “real” offer prices. The industry would benefit from shared development efforts, when investments in risk management or any other development program are not discarded immediately after the project completion, but they would become a part of the industry’s every day practices. A quality would improve. Co-operation would force people to get to know each other better leading to the development of closer trust-based relationships as opposed to evolve instead of traditional adversial ones. Closer relationships would make problem solving quicker and easier, if everybody knew who to trust that he or she would act as agreed. The risk that things may accumulate could be avoided or mitigated if actors dared to comment on others mistakes when they occur waiting for intervention on behalf of the main contractor. Close relationships have also enabled a “business friendship”, under this term; actors might be more willing to make special favours for other parties for the sake of the whole network to make it more competitive against other networks or individual players.

So, why these methods are not implemented to the construction projects? At the moment the main problems are that, first of all, the knowledge of the risk management processes is weak and its benefits are unclear. Learning from project to project is almost non-existent; there are no ways for tacit knowledge to be transferred. Secondly, the industry has for a long time relied on a strongly centralized network structure and actors have both accepted and expect those practises to continue. Thirdly, the industry has been driven to extreme price competition making all long-term investments and relationships difficult. Relationships are adversial and only on personal-level, not company-level. Since actors do not understand the possible benefits but only investments needed, motivation for improving the current practices is simply not there. Construction industry’s business culture and working practices sit tight and it is hard to

say that whether reducing transaction costs in this kind of environment is possible on a great extent.

How much actually could be gained by the construction industry from co-operation is yet to be determined, but the power of working together and a need to see the business in a wider timescale is evident. Short-term benefits should not be sought at the expense of long-term strategic advantage. The network governance theory supports the co-operative risk management model presented in this study. Based on the literature, significant benefits could be realised if the industry entered into more co-operative behaviour and risk management practices. The question is that which party will be the first to see the long-term benefits gained and start the change.

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Appendices

APPENDIX 1: QUESTIONAIRE

1. Taustatietoja
    a. Haastateltavan yritys, tehtävä
    b. Mikä on yrityksen rooli projektissa?

2. Verkosto
    a. Ketkä ovat lähimmät toimijat rakennusprojektissa?
    b. Miten heidän kanssaan tehdään yhteistyötä tässä projektissa?
    c. Kuinka tiivis ja läheinen yhteistyösuhde on? esim. Kuinka kauan yhteistyötä on tehty? esim. Kuinka usein samoissa projekteissa?

3. Riskienhallinta
    a. Mitä menetelmiä tässä projektissa käytetään riskienhallintaan? esim. Onko riskilistoja, palavereja?
    b. Miten riskienhallinta yhteistyössä eri toimijoiden kanssa on toiminut?
        i. tunnistaminen riittävän ajoissa
        ii. toimenpiteistä sopiminen ja niiden toteutus
        iii. toteutuneiden kustannusten jakaminen

4. Riskit projektissa
    a. Mitkä ovat tämän projektin merkittävimmät riskit?
        i. Miten riski tunnistettiin?
        ii. Mitä vaikutuksia tällä riskillä toteutuessaan olisi ollut/on?
        iii. Mitä toimenpiteitä sen hallitsemiseksi on tehty?
    b. Positiiviset riskit, eli mahdollisuudet joilla on positiivinen vaikutus projektin toteutukseen?
        i. Miten positiivinen riski tunnistettiin?
        ii. Mitä vaikutuksia tällä positiivisella riskillä toteutuessaan olisi ollut/on? esim. kustannussäästöjä
        iii. Mitä toimenpiteitä on tehty positiivisen riskin hyödyntämiseksi? Mikä estää sen hyödyntämisen?

5. Miten riskienhallintaa voitaisiin nykyisestä kehittää?