Traditionally innovation in the construction industry is analysed at an industry-level. This results in generalist observations on the low level of innovation when compared to other industries and the identification of factors that, on industry level, hamper innovation. With these factors in mind and having established a diagnosis on this level, numerous scholars, policy-makers and managers alike have prescribed therapies attempting to cure the industry as a whole. The case of the Dutch railways shows us that it is trust and loyalty between the people involved, their willingness to share knowledge and their entrepreneurship that made this inter-organizational co-operation function in such a way that innovation became possible. Trust, loyalty and entrepreneurship are primarily about people; not about organizations or about ‘the industry’. The Industrial Network Approach which explicitly identifies actor bonds as an essential part of an interfirm network, and the recognition of (emotional) trust as the essential factor for creating and maintaining such bonds, give us the concepts and frameworks to see and understand these phenomena.

Keywords: industrial networks, innovation, railway construction, strategic alliance, maintenance

INTRODUCTION

Traditionally innovation in the construction industry is analysed at an industry-level. On this level, a number of factors is mentioned which traditionally hamper innovation processes in the construction industry (Pries, 1995; Holmen et al., 2000). These factors are the unique nature of the product, the segregation of design and realization, the fragmentation of skills throughout the industry, the temporary nature of relationships, government regulations, the small average size of construction firms, the traditional tendering system and the relatively small amount of managerial attention which is devoted to issues such as strategy and innovation (‘engineers paradigm’). This results in generalist observations on the low level of innovation when compared to other industries and the identification of factors that, on industry level, hamper innovation.

With these factors in mind and having established a diagnosis on this level, numerous scholars, policy-makers and managers alike have prescribed therapies attempting to cure the industry as a whole. Various authors have argued that in order to stimulate innovation in the construction industry, the nature of relationships between actors within this industry should be redefined (Holmen et.al, 2000; Naylor and Lewis, 1997; Winch, 1989). For that reason, organizing innovation processes across firm boundaries by inter-organizational co-operation has become a contemporary theme in the construction industry. Firms are innovating by working closely together for a
series of several building projects. This inter-organizational co-operation replaces the fragmented organization of the building process with a more effective integration of resources and redefines the traditional boundaries between firms involved.

The objective of this study is to elaborate on the preconditions for organizing product and market innovations through inter-organizational co-operation. Based on the Industrial Network Approach a conceptual framework is discussed. In this framework a set of propositions on inter-organizational dimensions of innovation processes are presented. Empirical research was conducted by an in-depth case study of an innovation by an inter-organizational co-operation between the owner (Rail Maintenance, the organization responsible for realizing and maintaining the Dutch railway infrastructure), a medium-sized civil contractor, a small specialized subcontractor and a supplier of concrete elements. The main reasons for doing a case study were the importance of studying innovation processes in their real-life context and the explorative nature of this study (Yin, 1994).

The outline of this paper is as follows. In part one, the theoretical framework of the Industrial Network Approach is discussed. Part two presents the case study research design by discussing the method of data collection and the case firms involved. The preliminary findings of the case study are presented in part three. The paper is finished off with conclusions.

THEORETICAL FRAMEWORK

In our research we place inter-organizational co-operation within the Industrial Network Approach (Hakansson and Sharma, 1996). In this approach, firms are seen to be embedded in networks. Inter-organizational co-operation takes place within these networks. When this co-operation is aimed at improving the future position of firms involved, such relationships can be seen as strategic and are often referred to as strategic alliances. We would like to elaborate on a few aspects of networks.

Networks exist on three levels: actor bonds, activity links and resources ties (Hakansson and Johanson, 1994; see Figure 1). The activity level comprises links that are related to productivity. The resource level comprises ties that are related to innovativity. The actor level comprises bonds that are related to trust and identity. When focusing on co-operative innovation the actor and resource levels are the most important to consider. This type of product innovation will primarily be reflected in the creation of mutual orientation and formation of trust among individuals and firms (the actor level) and joint learning and adaptation (the resource level) (Holmen et al., 2000)

Business relationships in a network evolve in an organic way and can be seen as the result of a step-by-step process of social interaction (Hakansson and Sharma, 1996). These authors identify the following ingredients of this process: social exchange, adaptation and institutionalization.

Social exchange means that trust and commitment is built up over time. Adaptation means that the involved partners change parameters of their own processes and organization in order to function better in relation to the others. Institutionalization means that when parties co-operate over a longer period of time, the sense will develop between them that they ‘belong together’. Other parties will eventually also recognizes them as being ‘married’- being mutually committed over a longer period of time. This explains why in the Industrial Network Approach it is recognized that it is not only important to analyse the relationship between the firms directly involved in
the alliance, but that also the relationships between the alliance partners and other firms in the network should be regarded.

**Figure 1**: The three levels of a network (Hakansson & Johanson, 1994)

Various authors argue that an important element of social exchange and with it the evolution of networks is trust. Trust is regarded as the co-ordinating and binding element within inter-organizational co-operation. Klein Woolthuis (1999) identifies three types of trust: initial trust, competence trust and affective trust.

Initial trust can be described as an organization’s basic attitude towards inter-firm co-operation. A certain basic level of trust within an organization as part of its culture is seen to be necessary to make inter-firm co-operation work. Competence trust is seen as the confidence in the capabilities of the other party, which are ‘proven’ by the other’s performance in similar processes in the past. The third type of trust, affective trust, is seen by Klein Woolthuis (1999) as the most important form of trust. It can be best described as the emotional ‘click’ that can be felt between people involved in the inter-firm co-operation.

An alliance contract is drawn up as an overarching agreement that binds the different firms. It is this agreement which defines the targets, rewards and the interrelationships of the different parties. The contract plays the following roles (Klein Woolthuis, 1999):

- protection: protecting the organization’s knowledge from leaking away
- relationship: rules for managing the relationship
- trust: statement of mutual commitment

Klein Woolthuis (1999) found that the higher the level of trust, the more contracts would be characterized as ‘commitment-contracts’ and the more detailed they would be in the sense that they would resemble detailed working plans. This is somewhat contrary to the common belief that the lower the level of trust, the higher the level of detail in the contract. This could be true for the ‘protection’ aspects of contracts, but not for ‘relationship’ or ‘trust’ aspects. What is more difficult than committing yourself in detail to someone you don’t trust?
RESEARCH METHOD

The concept of creating innovations by interfirm relationships is a relatively new research topic for the building industry and successful cases have hardly been found and researched at all. Therefore, an exploratory research approach is appropriate, such as the case study approach described here. In this case study, Dutch-based firms were investigated: a medium-sized civil contractor, a small-specialized subcontractor and a supplier of concrete elements. These firms are involved in an inter-organizational co-operation focusing on innovation for a specific product-market segment, the product-market segment of traction tunnelling for underpasses under railway infrastructure. In addition to these three firms, the role of the client (Rail Maintenance) was also explored.

Traction tunnelling is a technique in which concrete elements are pulled through an embankment using hydraulic jacks. A steel cutting frame at the front of the tunnel cuts through the soil; the soil is then moved out from the inside of the tunnel using a small excavator. Soil friction is overwon by injecting the surroundings of the tunnel with bentonite. Traction tunnelling allows the overlaying infrastructure to remain in place (and often also in use) while the underpass is being realized.

The experience with the alliance for traction tunnelling was a major input for interviews with managers of the firms involved. The data were gathered by interviewing managers and supplemented with documentary information. The managers belonged to the higher management echelons of their firms. The interviewer followed a semi-structured questionnaire asking questions about the firm’s market and its strategic reasons for starting this alliance. Other items were preconditions and pitfalls for implementing the alliance analysed. In our case study, the companies of the alliance (except the owner or client, Rail Maintenance) appear under the following fictitious names:

- the medium-sized civil contractor: Cobuild;
- the small specialized subcontractor: Subcon;
- the supplier of concrete elements: Prefabrico.

PRELIMINARY FINDINGS

We used the concepts introduced in the theoretical framework to analyse our case. Based on this framework the following topics are addressed in this section:

actor bonds and resources ties of the alliance;
ingredients of social interaction;
different types of trust;
the alliance contract

Actor bonds and resources ties
As mentioned in the theoretical framework co-operative innovation will primarily be reflected in the creation of mutual orientation and formation of trust among individuals and firms (the actor bonds) and joint learning and adaptation (resources ties). For that reason, we will focus in this subsection on the identity of the actors involved in the alliance analysed and the innovative character of this alliance.

The different identities of the firms involved created the opportunity to create an alliance. Prefabrico is a manufacturer of prefab elements for traction tunnelling. On one hand, this firm needed Cobuild (a certified contractor with a lot of experience in railway construction projects) to realize a project for Rail Maintenance. On the other
hand, Prefabrico was an attractive partner for Cobuild (and other contractors) because the firm is not part of a large construction conglomerate. This meant that Cobuild could involve Prefabrico in this project without indirectly ‘sponsoring’ a competitor.

Subcon (the firm owning the traction tunnelling technique) needed Cobuild too. Subcon could not approach the Rail Maintenance independently because the firm was not certified. Moreover, due to its small size, problems could rise if Subcon would bear the project risks. Cobuild and Subcon (both contractors) were no competitors of each other. Cobuild was not perceived as a threat by Subcon, which had developed the traction technology and had over twenty years of experience with it. Subcon trusted that Cobuild would not develop this technique in-house. Subcon and Prefabrico are, in an existing partnership, market leader in traction tunnelling in road construction in the Netherlands.

The innovative character of this alliance is based on the introduction of traction technology in the market of railway-infrastructure. Rail Maintenance was in need of a technology through which underpasses can be realized while minimally disturbing railway traffic. The alliance of Subcon and Prefabrico with Cobuild offered Rail Maintenance an opportunity to employ such an innovative construction method. Rail Maintenance accepted the alliance because it appreciated the innovative input of the firms involved. Rail Maintenance was also prepared to bear a large amount of the risks involved this project. This proposal took away a major source of potential conflict about the question of risk sharing within the alliance. The characteristics of the project site, such as good soil conditions and a low level of technical complexity of the railway system (single track, no electrification), also provided the alliance partners and the client the opportunity to learn in a relatively low risk context.

The project was defined as a pilot in order to be excepted from traditional (European) tendering procedures. In such a tendering procedure, only existing techniques could be prescribed. In a pilot project, the alliance was assured a more attractive price for the project, thus encouraging them to introduce this method. The pilot project also gave Rail Maintenance the opportunity to experiment with the technology with ‘hand-picked’, experienced parties.

The process of social interaction

Hakansson and Sharma (1996) state that the process of social interaction in an alliance consists of the following aspects: social exchange, adaptation and institutionalization. We will now discuss these aspects in relation to the alliance analysed.

Social exchange is defined as trust and commitment built up over time. From a network perspective, Subcon played a major role in creating this trust and commitment between the firms involved in the alliance. The Subcon manager was part of two important bilateral management relations. First, the managers of Subcon and Cobuild know each other personally from social networks. For that reason, trust already existed between the management of these firms before the alliance started. Secondly, the co-operation between Subcon and Prefabrico existed already long before the alliance; the relation between Prefabrico and Cobuild was of a more traditional nature before the start of the alliance. Subcon and Prefabrico have been business partners for almost twenty years. With their innovative technology they tried several times together to get a project from Rail Maintenance. Until recently, the Rail Maintenance was not interested. At one time however, a project manager of an independent engineering firm, after having worked with Cobuild on a number of other railway projects and having discussed Subcon’s method of traction tunnelling with
Cobuild representatives, mentioned this technique to the Rail Maintenance’s project manager. The reputation of this engineering firm’s representative and his proven competence meant the client’s project manager could trust him and his advice to consider an experiment with traction tunnelling.

One speaks of adaptations when partners involved in an alliance change parameters of their own processes and organization in order to function better in relation to the others. The alliance in our case study consisted of managers that were able to influence these parameters. At the start of the first pilot project of this alliance, the choice between prefab and in-situ construction was a potential source of conflict. An important adaptation of Cobuild was the acceptance of prefab construction under the condition that this would be cheaper than in-situ construction. Subcon played the role of broker that brought Cobuild and Prefabrico together. It is plausible that the long-term partnership with Prefabrico stimulated Subcon to play this role. As a result, the demand for in situ construction in the project description was replaced by prefab manufacturing, which was indeed cheaper and could guarantee a high concrete quality.

Institutionalization means that when parties co-operate over a longer period of time, the sense will develop between them that they ‘belong together’. All firms supported the optimistic vision that a successful pilot project would stimulate the same partners to work together in a next project (based on the principle of ‘never change a winning team’). However, there was also a fear that the alliance’ success would at same time become its failure. The alliance partners were afraid that the technology developed would become an ingredient of future tenders by Rail Maintenance after this pilot project. There was a risk that from that moment on Rail Maintenance would prescribe the new technology in traditional tendering procedures. In this way, the knowledge developed by the alliance would leak away to the market and new competitors would be invited. In that case, the firms feared that Rail Maintenance would have only used the alliance for its own benefit.

In order to exclude such a risk and obtain an, in their opinion, fair reward for their innovation, the alliance partners attempted to obtain an exclusive concession for a series of projects using traction tunnelling. Due to its EU-obligation to tender its projects, it was not possible for Rail Maintenance to give such a concession.

This problem was dealt with in several ways. First of all, the traction technique will not necessarily be prescribed in future tenders in detail and as the only method allowed. It is sufficient for Rail Maintenance to prescribe a construction method on a higher abstraction level e.g. ‘a method using traction, pressure or other techniques, which allow the realization of the underpass without disturbing the railway traffic’. Secondly, the technology of traction tunnelling was kept at an arm’s-length distance from the client and the engineering firm involved. The design of the traction process was left entirely to the alliance. Finally, but very importantly, the alliance had a certain amount of trust in a professional, proper and discrete use of inside knowledge by the client and the engineering firm.

**Different types of trust**

Three types of trust have been identified in the theoretical framework: initial trust, competence trust and affective trust. According to the management of the firms involved in the alliance, these three types of trust were major preconditions for the success of the alliance.
First, a basic level of trust within an organization as part of its culture is seen to be necessary to make inter-firm co-operation work. This initial trust already existed between Cobuild and Subcon and between Subcon and Prefabrico. The firms Cobuild and Subcon were active in the same region and spoke the same ‘language’. Moreover, the managers of both firms have known each other personally from social networks. Subcon and Prefabrico have been business partners for a long time. These two bilateral commitments of the management of the firms in the alliance were an important source for initial trust between these parties at the start of the project. Perceived dishonesty and conflicts could be prevented. Openness among all parties on objectives, understanding each other business ‘drivers’, and alignment of individual interests resulted. Information (except information on costs and margins) would not be withheld, nor would it be distorted.

Competence trust, the second type of trust identified, is seen as the confidence in the capabilities of the other party, which are ‘proven’ by the other’s performance in similar processes in the past. For Rail Maintenance competence trust was based on the skills, experience and competence of Cobuild (Rail Maintenance knew Cobuild for a long time). Subcon was not known by Rail Maintenance but won competence trust by its openness about the traction procedure as applied in road construction, a plan for co-operation with the engineers, a systematic risk analysis and ‘what-if’ scenarios. In order to increase competence trust within his own organization, the client’s project manager involved, in a very early stage of the project, several stakeholders from his own organization. These stakeholders were the department which was to maintain the new infrastructure after completion (thus in fact ‘owning’ the new infrastructure) and the department which assesses and draws up specifications for new technology (the technological ‘conscience’ of Rail Maintenance).

Affective trust is defined as the emotional ‘click’ that can be felt between people involved in the inter-firm co-operation. As mentioned before, this affective trust existed already between the managers of Subcon and Cobuild. These managers have known each other personally from social networks. This affective trust was also based on individual backgrounds the persons, the language spoken, and the culture of the firms involved. Along the project, a personal ‘click’ has also grown between other individuals involved.

**The alliance contract**

*An alliance contract plays the following roles:*

Protection: protecting the organization’s knowledge from leaking away
Relationship: rules for managing the relationship
Trust: statement of mutual commitment

The alliance partners Cobuild, Subcon and Prefabrico drew up an alliance contract during the pilot project for Rail Maintenance. In this contract, the parties mutually committed themselves for the joint realization of traction tunnels in railway infrastructure. The alliance contract was signed for three years, with the possibility of silently prolonging by one-year periods.

The alliance contract is primarily a statement of mutual commitment and of trust. Relatively much attention is devoted to rules for managing the relationships within the alliance. Different scenarios are described for obtaining traction tunnelling projects and the ways in which the parties will introduce each other in such projects. Also, the boundaries of commitment are clearly defined, i.e. the situations in which the parties
are not bound to each other and in which there will be no mutual exclusivity. Only one four-line paragraph in the six-page contract is devoted to confidentiality and the protection of knowledge.

CONCLUSIONS

The case of traction tunnelling for Rail Maintenance shows that innovations can indeed occur in the construction industry. If we want to see it, we will just have to look closely and through the right ‘looking glass’. Our case study indicates that innovation in construction is not only a question of the behaviour of the industry as a whole, but also very much a question of the behaviour of individuals involved. If we want to analyse and intervene in this, we need a suitable paradigm. As we have concluded in the above, inter-organizational co-operation of a certain ‘strategic’ nature may be helpful (if not essential) to innovation in the construction industry.

Different types of trust and social exchange between the firms involved existed already on a bilateral level before the start of the project because managers have known each other personally from social or business networks. One of the firms played the role of broker facilitating adaptations needed. Trust was also based on individual backgrounds the persons, the language spoken, and the culture of the firms involved. Competence trust was based on the thorough process knowledge and experience of the firms. Firms had confidence in the capabilities of the other parties. On the side of the client, involvement of key stakeholders was necessary in order to obtain a right degree of trust within the own organization.

This innovation can be seen as quite an achievement, considering the potential pitfalls and the uncertainties for all parties. All people involved deserve credit for the way they overcame or worked around these pitfalls and made the innovation a success.

Firstly, they had to deal with the way the alliance operates in its own context. The way information about costs and margins was communicated within the alliance illustrates this. Although this type of information is considered to be valuable for developing products and maximizing total value for the client, the alliance partners were afraid if they mutually disclosed cost and margin information, they could use this against each other in transactions outside the alliance. The people involved had to deal with two ‘circuits’: one inside and one outside the alliance. For example, outside the alliance, Prefabrico could have to compete with other suppliers of precast concrete for delivery to Cobuild. In other projects it could even be a direct competitor as a contractor. And in the future, one of the firms in the existing alliance could attempt to start the same alliance with other parties. Behaviour inside the alliance was influenced by expectations on the behaviour of the parties outside the alliance.

Secondly, they faced questions about the relationship between the alliance and the client and the sustainability of the competitive advantage gained through the innovation. It is illustrated by the following dilemma, which is probably felt by many clients such as Rail Maintenance. On one hand, innovation demands for the encouragement of parties to invest in and experiment with new technology. This can be obtained by creating a unique market position for such parties. On the other hand, the client’s desire to benefit from a certain amount of market-dynamics and competition calls for technology diffusion and the introduction of new competitors. This demands for tendering procedures prescribing the application of this new technology or, perhaps on a higher level of abstraction, alternatives which offer the same benefits. These tendering procedures are not in the interest of firms that have
just invested in new technologies. By prescribing in detail the technology needed, the knowledge developed leaks away to the market. By prescribing alternatives, even on a high level of abstraction, competition is introduced and prices and margins are set under pressure.

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