Routledge
Taylor & Francis Group

Construction Management and Economics

ISSN: 0144-6193 (Print) 1466-433X (Online) Journal homepage: https://www.tandfonline.com/loi/rcme20

# Industrial renewal within the construction network

Håkan Håkansson & Malena Ingemansson

**To cite this article:** Håkan Håkansson & Malena Ingemansson (2013) Industrial renewal within the construction network, Construction Management and Economics, 31:1, 40-61, DOI: 10.1080/01446193.2012.737470

**To link to this article:** https://doi.org/10.1080/01446193.2012.737470

*Construction Management and Economics* (January 2013) **31**, 40–61

Routledge
Taylor & Francis Group

# Industrial renewal within the construction network

HÅKAN HÅKANSSON[1]* and MALENA INGEMANSSON[2]

[1]*Department of Innovation and Economic Organisation, Norwegian Business School, Handelshøyskolen BI, Oslo 0422, Norway*
[2]*STS Department, Uppsala University, Uppsala, Sweden*

Received 20 February 2012; accepted 3 October 2012

The construction business network is generally seen as conservative and non-innovative, for which a number of reasons have been identified. One of these reasons relates to the special inter-organizational setting that exists within the industry. The starting point of our study was to investigate whether there is any truth in this perceived lack of innovation. One reason for the industry's bad reputation could be that the way innovation generally is defined and measured is unsuitable for the construction business. Therefore, renewal was used as the central concept of change in our investigation. The second issue concerns factors that either assist or impede renewal, and the ambition was to identify those factors driving, as well as those hindering renewal. In order to identify the degree of renewal, as well as the factors affecting it, we conducted a survey of Swedish construction companies. The resulting picture shows a clear connection between the inter-organizational interfaces within the industry and how renewal takes place. The total renewal activity is on a considerable level with more than 60% having made changes visible from the customer's point of view. The most active interface is also in relation to customers, while the relationship to suppliers generally is more distant. Finally, the project focus which characterizes the industry affects what type of renewal takes place, and exposes the lack of knowledge transfer between individual projects and actors as an important hindrance to renewal in the construction network.

*Keywords:* Innovation, inter-firm collaboration, knowledge flows, learning, survey.

## Introduction

The construction business network plays an important role in the design and creation of the world we live in——it builds the environments in which we both work and play. The industry is also involved in building the infrastructure that enables communication, water and electricity supplies, as well as major parts of the waste management system. The construction industry thus plays a significant role in making many of the most essential parts of a community and a nation work. Furthermore, as we have all witnessed over recent decades, many of these aspects (for instance in terms of solutions for energy supply and consumption) have changed substantially in most countries. However, despite these major changes, the construction business network is generally seen as conservative and non-innovative (see e.g. Egan, 1998; Koskela and Vrijhoef, 2001; Seaden and Manseau, 2001; Miozzo and Dewick, 2004). It seems to be almost a paradox that, in spite of the many changes in the final products of the industry, the companies that are responsible for them are not seen as very interested or active in the development process. We find this paradox intriguing, and we consider a deeper investigation of the renewal activities of construction companies both timely and important.

When investigating what types of activity are being undertaken within an industry——innovative or otherwise——it is important to recognize how the activities in general are organized and divided among the different actors of that industry. One critical feature of the construction industry in relation to renewal activities is the dominant use of *project organization* (Winch, 1998). Almost all major construction projects are organized into a series of smaller, distinct projects. As a consequence, each project is handled in a specific way, which is determined by a specific manager (or

*Author for correspondence. E-mail: hakan.hakansson@bi.no

*Construction Management and Economics*
ISSN 0144-6193 print/ISSN 1466-433X online © 2013 Taylor & Francis
http://www.tandfonline.com
http://dx.doi.org/10.1080/01446193.2012.737470

group of managers), with a separate budget and decision-making structure.

This organizational aspect has been posited as one reason for a lack of renewal, which is expressed in the following way by Miozzo and Dewick (2004, p. 6):

> A key conclusion is therefore, that it is the project-based nature of these activities [designing, constructing, maintaining and adapting] that is important when considering innovation, because this creates discontinuities in the development of knowledge and its transfer within and between firms, and from one project to the next.

There have also been other explanations suggested and discussed for a lack of renewal. As is well documented in the construction industry literature, any construction project operates in a regulated context consisting of laws connected to public procurement and building standards, which is one identified obstacle to renewal within the industry:

> One of the problems with the construction industry is that construction facilities are large, complex and long-lasting, and they are created and built by a temporary alliance of disparate organizations concentrated temporarily on a single project and affected by standards, codes, tests, and provisions for consumer protection, safety and environmental awareness. (Miozzo and Dewick, 2004, pp. 5–6)

This is further emphasized by Blayse and Manley (2004), who identify the traditional 'lump-sum' contracts——which focus on price competition as a means of forming an efficient market——as an actual hindrance to renewal.

However, the opposite——a lack of competition——has also been suggested as a reason for a low level of renewal. Taking Sweden as an example, the view of competition as a main driver of technological and organizational development has, during the last decade, dominated the public policy perspective, and thus its prescription for increased innovativeness and productivity in the industry (see Ministry of Social Affairs (SoU) 2002; Ministry of Finance (SFD) 2009). This is partly an effect of a series of political reforms within housing politics that were carried out in Sweden at the beginning of the 1990s, which shifted the responsibility for residential property building, and consequently also how it would develop, from state to market (Lind and Lundström, 2007). In addition this shift has been reinforced through subsequent EU regulations (Lind and Lundström, 2011).

As such, the view of competition as the main driver of renewal (and the regulations and procurement systems that follow), stands in clear contrast to the vision of a more integrated and interactive supply chain, which is yet another type of explanation used by some scholars to explain the alleged lack of innovation within the industry (e.g. Akintoye *et al.*, 2000; Dubois and Gadde, 2002).

As we can see, the specific ways in which construction projects are organized and executed have been used to explain a perceived lack of technological and organizational development. From this we formulate the following research questions relating to how renewal occurs in the construction sector.

A first general question is whether the construction sector really is as non-innovative as has been claimed (at least in the Swedish public debate). One reason for its bad reputation could be that the way the concept *innovation* is generally defined and measured is simply not suitable for the construction business. Another potentially interesting factor might be variation within the overall structure——that some parts of it are not as conservative as others; and there are examples of renewal within the sector that certainly justify some investigation into this. Thus, the first research question concerns both *the degree and the variation of renewal within the construction industry*.

The second issue concerns *influencing factors*, some of which may encourage renewal, and others that impede it. Put differently: what are the reasons why the degree of renewal is at the level it is, and what explains any variation that may exist? The ambition is to identify *which factors act as driving forces to renewal, and which act to hinder it*.

Let us now look in a more detailed way at the hindrances to and drivers of renewal.

## Theoretical considerations

### Hindrances to and drivers of renewal in construction——a literature review

How renewal happens in construction, as well as what drives and hinders this process, is certainly a topic of many earlier investigations and studies (e.g. Slaughter, 1993; Egan, 1998; Seaden and Manseau, 2001; Love *et al.*, 2002; Blayse and Manley, 2004). In this section, we present a review of this literature, looking at four different (but highly interconnected) aspects of construction, where renewal takes place and where hindrances to and drivers of renewal have been identified. We relate these aspects specifically to the inter-organizational nature of construction activities. The first is *the organizational structure* in terms of the construction industry being a decentralized business and its activities being organized mainly into smaller

projects, which engage a number of different companies and organizations. The second category is *the process*, both in terms of how projects are divided into a sequential stream of planning and production activities with a number of different sub-processes, and how this (once again) involves a set of diverse actors. The third category is *the object*, which refers to the final construction product that contains a number of different components that must fit together. The fourth and final category is *the context* in which any project and process needs to operate, in terms of the regulations and standards.

The effects that the *project-orientation* has on renewal result in what the literature describes as 'issues of complexity' (Gidado, 1996), and 'matters of discontinuity' (Miozzo and Dewick, 2004). Winch (1998) discusses how the initiation and development of new solutions are never done by one firm, but by several of the other project members, which means using a new solution or attempting innovation necessitates a negotiation between different actors. There also have to be potential benefits for all parties in order for each to contribute to the new solution, which is a prerequisite in all innovation processes regardless of the type of industry (Ingemansson and Waluszewski, 2009). However, the project organization is also referred to as a 'source of innovation' (Slaughter, 1993; Winch, 1998). The project itself often contains problem-solving elements and, due to its one-off character, often throws up new issues that cannot be ignored and which need to be handled within the timeframe of the project. Over time, this creates opportunities to widely implement such new solutions (if long-term learning over the project boundaries is achieved) and also to generate knowledge about project organization and management (ibid.). However, the opposite view is that the most negative aspect of the construction industry in relation to renewal relates to difficulties in achieving collective learning over time (Barlow and Jashapara, 1998). Most innovations require that more than one actor learns, and by so doing, makes long-term change possible.

Miozzo and Dewick (2004) identify this not as a problem primarily related to project organization, but rather as a lack of cooperation within this inter-organizational environment in which any construction firm or other project member operates. In a study (comprising five European countries) of contractors' relationships with subcontractors, suppliers, governments, universities, clients and international collaborators, they concluded that the countries with the strongest inter-organizational relationships also had the highest productivity, which were Denmark and Sweden. Nonetheless, they also recognize the discontinuity that project organization brings in terms of posing a hindrance to long-term learning and therefore also to innovation. This is also noticed by Winch (1998, p. 273) who addresses the issue of needing to apply the knowledge gained from implementing a new solution in one project to successive projects in order for the new to actually become an innovation:

> For problem-solving to become innovation the solutions reached for the particular problem faced on the project must be learned, codified, and applied to future projects—knowledge that remains tacit is difficult to manage into good currency.

This type of project organization also calls attention to the complexity of carrying out construction activities—*the construction process* and the sub-processes it consists of. Construction projects often necessitate the assembly of a new onsite production facility, which needs to handle everything including logistical issues, the assembly of various components and prefabricated construction elements, onsite production of other components, and deciding who does what and when (Gidado, 1996). One aspect of the complexity in carrying out these construction activities, and thus also indirectly in carrying out innovation, is the number of different parties involved in the project, some of whom may not have cooperated before (Dubois and Gadde, 2002). This means that, while the purpose of the projects' organizational structure is to provide flexibility to the process (of being able to set it up 'anywhere' and interchangeably connect different sub-processes represented by diverse actors), it also creates a state where resources connected to considerations outside the project need to interact and adapt temporarily. This is possible when creating temporary solutions and adaptations, but it becomes harder to actually change these resources from a more long-term perspective, as this in most cases requires a relational component (of changing in relation to another actor). The complexity of developing an untested solution (or 'task difficulty' [see van de Ven and Delbecq, 1974]) then becomes not only to negotiate *why* a new solution should be tried, but also *how* it should be done. Will there be any benefits down the line?

The fragmentation of the production process, of separating the diverse range of specialist skills required for carrying out the construction process as a whole, has during the last decades increased considerably, which has further complicated the inter-organizational structure of construction activities (Dainty *et al.*, 2001). Traditionally, the supply chain that comes together for carrying out the different sub-processes within a project is also a 'loosely' coupled network with few long-term relationships (Dubois and Gadde, 2002). While closer client–contractor relationships are

endorsed the connections in the remainder of the supply network are weak. According to Dainty *et al.* (2001) this forms a 'process hierarchy' in which subcontractors have a subordinate position and where pressure is placed on those at the next (lower) hierarchical level. This tends to result in 'strained and adversarial' (ibid., p. 165) relationships between main contractors and subcontractors and creates difficulty in achieving a more integrated supply chain. Undoubtedly this has implications for the achievement of renewal.

The conclusion of this discussion is that inter-organizational issues need more attention and in the next section we will continue to relate them to the four earlier identified aspects.

## A need to investigate inter-organizational issues

As we have already touched upon, one important aspect of project organization, and also of how the construction process is handled, is the types of relationship that are endorsed in the industry. A common observation is that the industry suffers from 'loose' upstream linkages, i.e., that there is little long-term commitment to suppliers and manufacturers, which leads to missed opportunities for innovation (e.g. Atkin, 1999; Dubois and Gadde, 2002; Miozzo and Dewick, 2004). However, the industry has for some time been developing——as reported in a number of studies——*partnering relationships* with clients (e.g. Bresnen and Marshall, 2000; Bygballe *et al.*, 2010; Gadde and Dubois, 2010). While these are viewed as positive for innovation from the perspective of closer interaction leading to more comprehensive and long-term learning situations (Miozzo and Dewick, 2004), Bresnen and Marshall (2000) also state that there is little coherence in the definition of *partnering*, and that the term is sometimes applied to any 'non-adversarial relationship' (2000, p. 232). They distinguish between two different understandings and uses of the term: (1) that it is an organic type of interaction that evolves into a close relationship between two parties as they over time realize the benefits of not using tendering procedures, and that it is this long-term interaction that brings efficiency advantages; and (2) that it is purely a contractual agreement for a specific project, and that it is possible to reap short-term benefits from such a relationship. These two types of partnering obviously have very different effects on the likely achievement of innovation.

Often there has been no prior understanding or cooperation between the parties when they come together for a construction project. Instead, each party comes into the project with its own particular set of resources (e.g. products, equipment, knowledge, relationships). These are resources that may represent years of investment, and which are connected not only to each other (e.g. the features of the products and the equipment used), but also to resources controlled by other actors (Bengtson and Håkansson, 2008).

Gann (2000) proposes that in order to grasp the way innovation happens in construction, the industry (and the other industries it utilizes) must be viewed as a 'construction system' in terms of the different actors and relationships that it comprises, and the inputs and outputs that they generate. The relationships between producers and users are given particular attention, as he considers the understanding of users' needs essential for the achievement of innovation.

While the structural organization of actors and activities (into separate projects and in the construction process) are two aspects greatly affecting renewal in construction, the arrangement and perspective of the physical components composing *the construction object* is certainly another. Examining the users' (i.e. builders') role in driving innovation in her field study of the residential construction industry focusing on one particular technological innovation (a new type of panel), Slaughter (1993) found that builders often acted as drivers of technological innovation. One of the reasons behind this was their ability to profit by learning how new technology might be used in future projects, while this was not relevant for the manufacturers, who handled only discrete parts of the technology. The study also showed that, while the manufacturers were only concerned with their own components of the panel, the builders viewed the panel as part of a greater component system, which needed to fit to contribute to the construction object as well as the project as a whole. This resulted in the builders contributing various new uses for the panel, and they thus acted as drivers of innovation. Therefore, the question of whether the different actors are engaged in the construction object as merely an assembly of separate parts, or as an entity comprised of interdependent components, seems to have a great bearing on their role, and how technological renewal activities are undertaken.

As such the construction object connects the actors in an undisputable way: the components of the object need to fit together, which requires a certain level of interaction between the actors in order to create a match between their resources. However, as earlier stated, in construction this type of match between companies' resources can largely be achieved through temporary adaptations for separate objects. Long-term change that widely affects these components and the object, or what could be identified as innovation, on the other hand requires a systematic combining of

resources between specific companies that change jointly.

One of the explanations used for why the interactions between the different actors are as they are in this particular industry is the regulatory framework or context in which any construction project or process needs to operate, and which also takes part in shaping the final construction object (Blayse and Manley, 2004; Miozzo and Dewick, 2004). The interpretation of the public procurement regulations is often strictly focused on price as the sole determiner of what defines the 'best bid' and this view also characterizes most parts of the supply chain (Bygballe *et al.*, 2010). Tendering procedures based on price competition as a way to organize the market are in turn based on the traditional market model in which competition is one of the main mechanisms of achieving an efficient market. This has also been a recurring basis for policy recipes of how to achieve a more innovative and productive industry——more competition (Bygballe and Ingemansson, 2011). However, in the light of the literature and studies here presented it appears that this market organization acts rather more as a hindrance to than as a driver of innovation.

It seems to us that there is a need for a study where renewal in the construction industry is studied with a theoretical model and a research method based on an inter-organizational approach. One such example is the industrial network approach. In the next section, we will use this approach to formulate the research task in a more precise way.

## Industrial network approach

There are two more major reasons for applying the industrial network approach to the construction industry: first, a construction company uses a set of suppliers of both materials and services (subcontractors), which usually accounts for 60–70% of total volume (Dubois and Gadde, 2002). Secondly, the constructions——houses, office buildings, roads or dams——are mainly done for corporate customers. A construction company, in this way, acts in a business-to-business (B2B) situation both on the input and output sides——in other words, a very typical industrial market/network situation. Earlier theoretical and empirical results using this approach should therefore be both applicable and of interest (for an overview see Håkansson *et al.*, 2009).

An industrial network approach, therefore, seems to be a reasonable approach and should give interesting, complementary and useful insights, both in terms of how to study innovations/renewal and for identifying factors that either drive or hinder renewal in the construction industry.

To accomplish this, we will use the ARA-model (Actors-Resources-Activities) (Håkansson and Johanson, 1992) both as a starting point for discussing how to identify and define renewal and also to identify factors affecting it in both a positive and a negative way.

The industrial network approach is developed out of a large number of empirical studies where it has been shown that business relationships developed between buying and selling companies can have several different important economic functions. In the first studies (e.g. Håkansson, 1982) the contents of business relationships were documented and analysed indicating their duration, complexity and economic weight. The analysis indicated the importance of adaptations, learning and mutual trust. In a second step the connections between the relationships were documented and analysed (e.g. Håkansson and Snehota, 1995). In all major relationships there are important connections to other relationships that the two counterparts have and sometimes also relationships between third parties. Every relationship is in this way embedded into a network of relationships. The ARA-model combines the substance in the relationships with their connectedness (Figure 1). Starting with the three substance layers of the model a relationship can first link the activities on the two sides to each other in such a way that the total efficiency is increased. Secondly, the relationship can tie the resources on the two sides to each other in new ways creating new resources combinations. Furthermore, the relationship will be and should be handled as a resource in itself——maybe the most important resource for the single company. Finally, it can bond the two involved actors to each other through creating mutual positive sentiments thereby affecting the way they treat each other. Turning to the three columns indicating the connectedness,

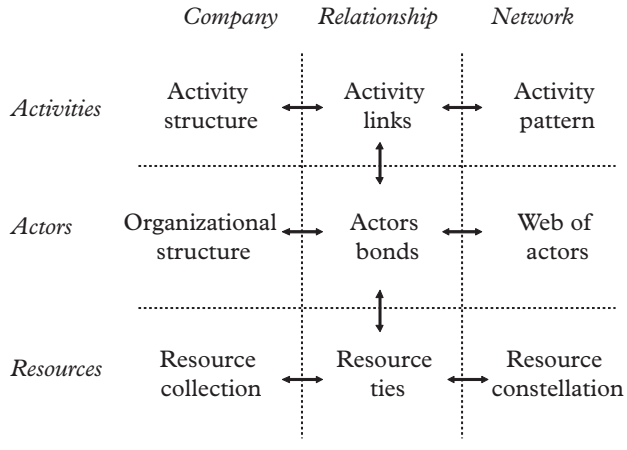


**Figure 1** The ARA-model (Håkansson and Johanson, 1992)

developed business relationships are systematically relating different internal aspects of the company to specific counterparts and thereby becoming a part of the larger network (relating to third parties). Thus, it is part both of the single company and of its environment. It is embedding the company into its environment. The boundary between the company and the environment is blurred and the company can influence specific counterparts in a much more direct way at the same time that the counterparts can influence specific activities and resources within the company in a much more direct way than is assumed in a market model.

The existence and importance of relationships give an opportunity to study changes such as innovations in a new way. A change in terms of a new product or a new process on any side of the relationship will affect it in terms of changes in links, ties or bonds (Figure 1). There has to be a renewal of the relationship and this renewal can be used for identification of all large changes in the two counterparts at least if they have a significant relationship. If one actor changes in some important way, it will always affect its major relationships, as these are an integrated part of the company. One way to identify the use of an innovation applying the ARA-model is consequently by focusing on links, ties or bonds (Figure 1). Any innovation of some magnitude that changes the activities or resources of any of the two actors will be mirrored in the relationship between them——there has to be a *renewal* of the relationship. It means that a renewal, applying the network model, requires that at least one of the actors be changed in a way that affects the other. It is important to note not only that all such renewals are not necessarily innovations, but also that they will cover all changes that have effects similar to a true innovation (if defined as the widespread use of a new product or process, see e.g. van de Ven *et al.*, 1999; Fagerberg, 2004). Thus, by focusing on renewal, we will cover all innovations and other major changes (such as substantial learning) that will have the same effect as an innovation. So, if we want to start to look for renewal of an actor——such as a construction company——we could, for example, try to identify this in relation to important counterparts such as its main customers or suppliers. Furthermore, we would also have to look into the ties, links and bonds. In this case, a renewal could either be a new way of working with a counterpart (a new type of bond), it could be that the activities are designed and related to a counterpart's activities in a new way (links), or it could be that the resources used are different or related to a counterpart's resources in a new way (ties). Thus, there is a need to cover the most important relationships for a company in order to identify both the degree of renewal as well as the *important types* of renewal.

On the influencing side, in terms of what affects the degree and variation of renewal we can use the industrial network model to identify a number of influencing factors. These factors range from the general network situation of a company or project, to a number of competence and organizational factors; some of these will be seen by the managers as driving forces (strategies, competence-building, courses, etc.), i.e., factors that positively affect renewal. Others will, in general, be regarded as factors hindering renewal work.

We start with the most general factor that the network theory suggests should affect a single company, namely the type of network position it has (Henders, 1992; Johanson and Mattsson, 1992). Here we have a network that, for some construction business units, has both an 'internal' and an 'external' part. Construction companies are, due to their project-based focus, decentralized while, at the same time, there are a few major companies that dominate the Swedish construction network. A consequence of this is that many projects are handled by a local unit within a large, decentralized company. All of the business units within large companies have a network that consists of both what could be described as an *internal network*——all the projects and units within the wider company——in addition to the *external network* that all these separate units have. The external network consists mainly of customers, suppliers and competitors. Furthermore, the local character of the network also necessitates consideration of the local network's position. For example, there are significant differences for units existing in large cities compared to those outside, in terms of customers, subcontractors and suppliers. The type of customer and supplier differs according to the type of project in which the business unit specializes.

When looking for perceived driving and hindering factors, we can use Figure 1 to identify a number of possible types. First, the columns can be used to identify factors related to the single actor, to relationships with counterparts, and to the larger network. Within each of these broad categories we can look for factors related to the organization, to specific resources or activities. If we start with *relationships* we can find driving or hindering factors in relationships with customers, suppliers, subcontractors and technical specialists including architects and/or governmental bodies. In the *network* we can identify driving or hindering forces in the way the network works according to how its members function (type of relationships applied), and changes in how the resource constellation is brought together or the wider pattern of activity

is formed. Finally, in the single *company*, new ways of planning projects or organizing the labour force could be examples of factors that affect how relationships to customers function.

## Method

### Focus of study

The inter-organizational challenges, to which previous literature on innovation in the construction industry both directly and indirectly points, indicate a clear need to identify the different types of interfaces to which individual construction companies relate and need to handle in terms of renewal. Here, we examine this issue by investigating the types of actors with which the construction companies interact (or don't interact), the types of activities that are renewed in some aspect or that drive or hinder renewal processes, and the types of resources (physical and/or organizational) that are renewed or which might be involved in driving or hindering renewal. The purpose of this study is to produce an overview of the renewal that is happening in the Swedish construction industry in relation to these interfaces and, as stated in the introduction, we want to get an indication of: (1) the degree of renewal; (2) the variation of renewal; and (3) factors influencing renewal in terms of acting as driving or hindering forces.

Having 'the company' as a unit of analysis (and the other entities in the network to which it relates) and wanting to identify what type of company engages in what type of renewal, we considered that a survey of the Swedish construction companies was a suitable approach. We chose CEOs and unit managers as respondents, as they would probably have a good overview of the company's renewal activities over preceding years. The survey was thus used to get a broad view of how key people within the industry perceive the problems and opportunities of renewal. We asked these business managers (CEOs of independent companies and managers responsible for a division, or local region in the three largest companies) to give their take on: (1) what has happened during the last five years; (2) what they perceive as motivations and impediments to renewal; and (3) what they think is necessary and/or possible to renew within the next five years. In addition to the survey, we conducted 13 CEO interviews covering the largest construction companies in Sweden, as well as a selection of small and medium-sized construction companies involved in excavation work, housing and property building throughout the country. These interviews gave us not only a view of the Swedish construction industry but also an international outlook as many of the CEOs were very familiar with and act within an international setting. This broadens the perspective of this study to also encompass conditions of the industry outside Sweden to which we have been able to relate our findings.

The risk of addressing managers in a survey like this is that there might be a tendency to overstate what has actually been achieved and, in this case, a possible exaggeration of the renewal of the company. However, by informing the respondents that the survey would be completely anonymous, this risk was hopefully minimized. It might also be the case that managers focus only on particular types of achievements, or hindrances to and drivers of renewal. However, as we were asking about different types of renewal on a rather general level (compared to asking for very specific details) and inquiring about many different activity areas of the company's operations, we identified the manager as the best-qualified person to answer the survey. The types of renewal, drivers and hindrances were also pre-specified in the survey, which meant that the respondent merely had to grade the company's degree of the different types of renewal, and their relevant driving or hindering forces. This should also have reduced the possibility of respondents focusing entirely on just some aspects of renewal. Finally, the CEO interviews have given us a deeper understanding of the survey results, and some further insight into how they can be interpreted, besides being a very useful check of the relevance and usefulness of the survey.

### Survey design

In formulating our study, as well as the survey, the theoretical approach presented in Figure 1 was used to identify both the dependent and independent variables. The dependent variable——the renewal of the construction company and its projects——was the first issue. We needed a main reference point, so we chose the company's relationship to its customers. Our general measure of the results of all renewal activities was, in this way, identified in relation to customers. The existence of positive changes for customers over time became our primary way of identifying the results of all renewal activities. More specifically, we asked the respondents to specify the degree to which renewal had helped to give customers a more valuable product ('more valuable' including the same product for a lower price, or a better product for the same price). The next step was to identify how the renewal had manifested itself, which required the mapping of specific changes in the ties, links and bonds. For each of these we identified some typical types of renewal that had been generally observed or

discussed within the industry (e.g. changed competence, changes in purchasing, use of technical platforms, etc.). By asking about the degree to which changes had taken place during the last five years, we could at least identify how the key persons within the companies perceived the degree of renewal according to each set of factors.

In order to identify the driving and hindering factors of renewal, we identified suitable questions/parameters using two dimensions. One of the dimensions was *type of counterpart*. In total, we identified 11 types of counterpart (customers, suppliers of materials, suppliers of equipment, subcontractors, foreign material-suppliers, foreign subcontractors, other construction companies, other foreign construction companies, technical consultants [incl. architects], research institutes, university departments). The second dimension concerned the *range of activities and/or resources* that could be related to the interfaces with different counterparts; some of these were: planning, platforms, competence, technical problems, courses, cooperation, ideas and information. With the help of these two dimensions, it was possible to compile a large set of factors that could be put to the managers to evaluate the degree of renewal for these activities/resources, and also the factors affecting the same.

Table 1 displays the range of questions covering renewal areas and the different aspects identified as connected to renewal: network position, driving and hindering forces (see Appendix 1 for a full account of the categories covered by the questions and for further insight into the categories/variables defining renewal, network position, driving and hindering forces). The questions also relate to both internal and external interfaces of the individual company. Starting from the top of the table, eight questions concern the basic characteristics of the companies, which were designed to make it possible to categorize the companies in terms of their position within the network. More specifically, these questions relate to a set of variables indicating, for example, size (in relation to the overall network), whether the unit exists within a larger company (an 'internal' network), type of local environment (large city or small town etc., to give an indication of the size and complexity of the local network), and the degree of international purchasing

**Table 1** The renewal-related aspects covered in the survey and types of questions posed

| Renewal-related aspects | Type of questions | Type of interfaces | Number of questions |
|---|---|---|---|
| Network position and classification of the company | Type of unit | Internal/ External | 8 (covering different aspects of the company) |
| | (See Appendix 1 for the categories) | | |
| Renewal (both technical and organizational) | To what extent has your company developed during the last five years giving your client a more valuable product | In relation to customers | 2 (covering a total of 10 different renewal areas) |
| | Grade to what extent you can observe changes in the company for the following categories during the last five years | Internal/In relation to other actors | |
| | (See Appendix 1 for the categories) | | |
| Driving forces | Grade the importance of the following sources for new ideas and solutions for the company | Internal/In relation to other actors | 3 (covering a total of 21 different types of driving forces) |
| | (See Appendix 1 for the categories) | | |
| | Grade the extent to which the following activities are used for learning and skills development | | |
| | (See Appendix 1 for the categories) | | |
| | Grade the extent to which the following activities for learning and skills development need to increase in the future | | |
| Hindering forces | Grade the extent to which the following aspects hinder renewal | Internal/ External | 1 (covering a total of 12 different types of hindrances) |
| | (See Appendix 1 for the categories) | | |
| Future development areas | Grade the extent to which the following aspects need to develop for increased renewal | Internal/ External | 1 (covering a total of 17 development areas) |

(how extended is the international network). Two very central questions to our study concerned the renewal aspect of the companies. In the first question, the respondents were asked to rate the degree to which their companies had renewed their activities during the last five years, in terms of giving their customers a more valuable product. In the following question, respondents were asked to mark off specific technical and organizational changes that had taken place during the last five years. The next three questions concerned the forces that promote renewal. In the first question, respondents were asked to mark-off specific sources of inspiration for new ideas and solutions, specifying any counterparty involvement. Two questions were then devoted to learning, and how skills development is handled within the company and in relation to other actors. These questions were used to record which type of renewal sources are endorsed, and concerned both what is being done now and future areas for improvement. The last two questions were devoted first to specific barriers to renewal——to which respondents could indicate varying degrees of impact——and secondly to future development areas and their likely relevance in improving the overall innovativeness and renewal within the industry.

## The data collection

To test the overall relevance and effectiveness of the survey we conducted three test interviews with experienced unit managers within the industry at different geographical locations; we discussed possible improvements to the survey in terms of clarification, as well as adding or subtracting specific questions. These interviews resulted in a considerable improvement to the survey, mostly in terms of increasing the precision and relevance of the questions. For the 13 complementary CEO interviews, a selection of questions from the survey was used as an interview guide to get a more profound understanding of the answers provided by the other respondents, and also to be able to get real examples of various renewal efforts and the types of driving and hindering forces that we address in the survey. On average, each interview lasted for about two hours.

The survey was sent to 2213 managers in Swedish construction companies that were members of the Swedish Construction Federation (SCF). Keeping in mind the aim of studying renewal in an industrial sense, we only selected companies that had five employees or more. As an important aspect of our investigation was to determine the possibility of a variation of renewal within the construction network, as well as the reasons for such a variation, we needed to strive for a reasonable representation of the population in question. Owing to the structure of the industry (in which more than 95% of the companies are very small with only 20 or fewer employees, but where the three largest companies account for about half the market in terms of total turnover [Swedish Construction Federation, 2011]), a special problem was the skewed distribution of these larger companies in relation to the large population of small companies. Therefore, in each of the three largest companies in Sweden, we identified 80–100 business or unit managers who, by acting as respondents, would effectively 'split' these companies into multiple actors. For the rest of the companies (the independent companies) the survey was sent to the CEO.

A web-based tool (Questback) was used to distribute and collect the surveys, which also facilitated further analysis of the final sample. To motivate these companies into taking part in the survey, a letter from the CEO of the SCF (emphasizing the importance of the study) was included. In the first round, we received 270 responses and, after the first reminder, another 100. After the second and final reminder we received 71 responses, leaving us with a total of 441 completed questionnaires. The breakdown of the sample is shown in Table 2 by size, location, unit within larger company or independent company, level of international purchasing (as a share of total purchasing), and type of production (as a dominant share of total turnover). Although business units within the three largest companies only represent 26% of the sample (in comparison to representing half the market in terms of turnover), our conclusion is that this is a satisfactory share for the purpose of our study.

In the following section, the results are presented in tables showing the percentages of how respondents, for instance, have graded the extent to which specific renewals have taken place, or the importance of particular sources of new ideas and solutions. We analyse these percentages based on the assumption that the total population consists of all the members of the SCF (with five employees or more). This provides us with confidence limits (in a 95% confidence interval) for our sample in the range of ± 4% (or less). This in turn means that the percentages shown in our tables throughout the paper (e.g. of how many companies state that their planning level has increased considerably during the last five years, or of how many companies state that their clients are the most important drivers of renewal, etc.) are in the range of ± 4% (or less) from the given estimate. Given the size of our sample and the rather clear-cut tendencies in the data material, the results of the survey provide us with a good basis on which to discuss the conditions in the industry.

**Table 2** The response frequency in relation to five different groupings

| Properties of the companies | Share of companies (%) |
|---|---|
| *Type of unit* | |
| Unit within larger company | 26 |
| Independent company | 74 |
| *Size of business unit* | |
| 5–50 employees | 70 |
| 51–200 employees | 22 |
| 201 or more employees | 8 |
| *Location* | |
| Larger city (Stockholm, Gothenburg, Malmo) | 41 |
| University or college city (outside the larger city areas) | 25 |
| Other locations | 34 |
| *International purchasing* | |
| 0–2% of total purchase | 67 |
| 3–4% of total purchase | 6 |
| 5% or more of total purchase | 27 |
| *Type of production* | |
| Housing—new production | 15 |
| Housing—rebuilding | 19 |
| Property building (offices, schools, etc.) | 36 |
| Large infrastructure | 13 |
| Excavation and foundation work | 25 |

The analysis has been done in two major steps: in the first, the empirical material is described in a general way, where different dimensions of renewal are related to single dimensions of network position, as well as driving and hindering factors. In the second step, the different variables are brought together into a structural equation model to identify how the different single dimensions together form a totality. The structural equation model is explained in detail in the Results section.

## Results

### Renewal

The survey shows that, despite the harsh critique of recent decades of not being innovative enough, the construction industry is involved in both organizational and technological development. On the question of the degree of value-adding development that has taken place in the companies during the last five years, 22% claim that considerable renewal has been carried out in relation to customers, while 39% claim that at least a few changes have taken place adding value for the client (see Table 3). Taken together this means that 61% of the companies state that at least some changes have been made, and that these have added increased value for the client. Thus, almost two-thirds of the companies claim that they have developed their business to the degree where it leads to their clients getting a more valuable product. However, it also means that the remaining companies, which state that nothing really important has happened, account for 39% of the sample.

Further, the responses indicate that the changes are organizational rather than technological (see Table 4). *Partnering relationships with clients* is the area where the most 'considerable' renewal has taken place. Increased *planning level* and *quality of project work* indicate that there are changes going on, not only within companies, but also in relation to external actors which are essential for the improvement of these two types of activity. Although it is not indicated what types of changes or improvements have been carried out, both *planning* and *project work* involve a set of different actors (such as the client, subcontractors, technical consultants and specialists).

Even though there hasn't been a 'considerable' increase in *share of subcontractors and specialists* or *share of prefabricated materials and construction elements*, more than half of the companies state that these are areas

**Table 3** Degree of renewal in relation to customers during the last five years

| Renewal in relation to clients during the last five years | Share of respondents (%) |
|---|---|
| Considerable changes have been implemented in how project work and production are carried out, providing the client with a significantly more valuable product. | 22 |
| Quite a few changes have been implemented in how project work and production are carried out, providing the client with a slightly more valuable product. | 39 |
| A small number of changes have been implemented in how project work and production are carried out—it is basically the same as before. The client is provided with a marginally more valuable product. | 18 |
| No changes have been implemented since there is no need. The same robust methods are used for project work and production, providing the client with the same value as before. | 21 |

**Table 4** Areas of renewal

| Renewal categories | Share of respondents stating that there has been a considerable increase (%) | Share of respondents stating that there has been a slight or a considerable increase (%) |
|---|---|---|
| Partnering relationships with clients | 21 | 61 |
| Planning level of production | 13 | 69 |
| Quality of project work | 12 | 60 |
| Share of foreign labour | 9 | 37 |
| Share of international purchases of materials | 8 | 33 |
| Share of subcontractors and specialists | 6 | 56 |
| Share of prefabricated materials and construction elements | 6 | 53 |
| Share of projects involving virtual construction | 6 | 32 |
| Standardization through technical platforms | 5 | 42 |
| Share of international purchases of subcontractors | 4 | 22 |
| Average | 9 | 46 |

in which renewal has taken place. An increased share of subcontractors and specialists indicates that the companies are becoming increasingly specialized, and thus outsource more and more of their former activities to other companies. In turn this suggests that construction companies are becoming even more dependent on other companies in the fulfilment of their obligations to their clients; the more that is outsourced to other companies, the more the contractor becomes a coordinator of those activities and resources that need to function together within any construction project. This puts higher demands on the single construction company's ability to interact with subcontractors and specialists in providing a robust product to the client, and is generally changing the contractor's position and function within the construction network. This also applies to the evident increase in the use of prefabricated material, which is purchased from different suppliers; this seems to be a developing trend in the construction network that might have a positive effect on some companies in terms of increased efficiency, but at the same time a less positive effect on others, such as certain subcontractors, as it eliminates the need for specific operations and skills on site.

On average, about half of the companies claim that there has been some sort of change in the selected areas of operations concerning construction activities and resources (see bottom of Table 4). However, on average, less than 10% state that there has been a 'considerable' change, of which a great part is accounted for by *partnering relationships with clients*. This suggests that, although change is taking place in the construction network, generally it is rather moderate and mainly involves the business model applied to handling clients.

## The main driving forces of renewal

Since learning and knowledge development are key components both for the development of any business relationship as well as for any single company, understanding how learning is handled within the construction network is crucial to understanding the driving forces of renewal. Looking at how the companies handle knowledge development, it is however clear that in construction the foremost source of knowledge is internal: *learning by doing* through mentoring or coaching from others within the same company is the most frequently used form of skills development (see Table 5). *Exchanging experiences from finished projects* comes in second and, while this is an activity that might include other actors, it is in many regards about sharing knowledge within the company rather than interacting with others. It does, however, include an evaluation of the relationships with these other actors, which also most respondents think should increase in the future, thus highlighting the problem of constantly doing new types of projects without set routines of how to process and utilize all the available experience. Another indication of the internal focus is the relatively high percentage of

**Table 5** How knowledge is acquired within and between companies

| Ways of skills development | Share of respondents stating this is currently in frequent use (%) | Share of respondents stating this should increase within the foreseeable future (%) |
|---|---|---|
| Learning by doing (through mentorship, coaching, instructions) | 89 | 55 |
| Exchanging experiences from finished projects | 59 | 71 |
| Internal courses | 46 | 52 |
| Courses and meetings arranged by suppliers | 45 | 37 |
| External courses | 40 | 50 |
| Study visits and discussions at clients' place of business | 39 | 55 |
| Study visits at projects within the same corporation | 23[a] | 46[a] |
| Further education at university level | 1 | 23 |

*Note*: [a] This question was only answered by business units within a larger corporation.

companies frequently running *internal courses* that also expect this to increase in the future. There are, however, signs of companies learning through interaction with other actors through, for instance, *courses and meetings arranged by suppliers*, other *external courses*, as well as *study visits and discussions at clients' place of business*.

The question is, however, the degree to which such interaction takes place. The responses to the question about the most important driving forces for renewal show that most of the companies consider their internal resources and their clients most crucial (see Table 6). In addition, increased collaboration with clients is considered the most important development area for future renewal (see Table 7). Subcontractors, consultants, architects, material suppliers, and above all equipment suppliers, all get significantly lower scores (in regard to both current and future driving forces), which indicates either that there is not much interaction in this part of the construction network or at least that the construction companies do not acknowledge it.

**Table 6** Perceived driving forces of renewal

| Driving forces of renewal | Share of respondents stating this is currently a very important driving force of renewal (%) |
|---|---|
| Ideas and opinions from co-workers | 78 |
| Ideas and opinions from clients | 77 |
| Technical problems requiring a solution | 46 |
| Ideas and opinions from subcontractors | 31 |
| Ideas and opinions from technical consultants and architects | 28 |
| Common efforts within the corporation | 26[a] |
| Ideas and opinions from material suppliers | 21 |
| Competition from Swedish construction companies | 20 |
| Courses | 17 |
| Ideas and opinions from equipment suppliers | 13 |
| Information from governmental authorities | 13 |
| Competition from foreign construction companies | 12 |
| Information from research institutions | 9 |

*Note*: [a]This question was only answered by business units within a larger corporation.

**Table 7** Areas perceived as important development areas

| Development areas that can act as driving forces of renewal | Share of respondents stating this is a very important development area for future renewal (%) |
|---|---|
| Increased collaboration with clients | 57 |
| Increased focus on ethical business conduct[a] | 56 |
| Labour contracts for construction workers | 47 |
| Leadership with increased focus on renewal | 45 |
| Competence level within the industry | 39 |
| Increased collaboration with subcontractors | 38 |
| Exchange of experiences between projects | 37 |

*Notes*: Only the areas that received the highest scores are included.
[a]Ethical business conduct refers to zero tolerance of cash-in-hand jobs and cartelization.

Subcontractors, consultants and architects get a somewhat higher score, which might be explained by the fact that these actors often provide specialized services adjusted to each project, which potentially makes them more likely collaborators (see Table 6). The low level of interaction with material and equipment suppliers, on the other hand, is an indication that these are used to provide more standardized solutions that are not tailored for every project.

Foreign construction companies, interaction with governmental authorities, universities and research institutes all score very low both as current and as future sources of renewal (in the latter case they all score lower than 16%). Partly, this is an effect of the industry being mostly comprised of small firms with little occasion to interact with international corporations or authorities involved in regulation and research. Even so, it is an indication of a low degree of interaction with these external sources of knowledge, which reinforces the common image of the construction company as a quite isolated organization with a particular focus on its internal activities.

Other important development areas seem to be an increased focus on ethical business conduct, with reference to zero tolerance of 'cash-in-hand' jobs and cartelization, as well as new labour contracts for construction workers. While the former is part of a larger political debate (that has got a lot of media attention in Sweden), the latter is directly connected to how construction workers doing piecework do not get very involved in the goals of the project as a whole, and work with quantity as a goal rather than quality; according to the CEO interviews, this provides little incentive for construction workers to try to find new ways of working or engaging in the project as a whole.

## The main hindrances to renewal

The most important hindrance to renewal, as identified by the respondents, is the strong focus on price in all parts of the supply chain (see Table 8). Tender procedures and price competition are characteristic features of the industry, and evidently they are also considered obstacles to renewal. Another commonly experienced hindrance is that there is too little time between the client ordering a project and the start of production; this means that the construction company has to logistically plan the project, order material, hire subcontractors and so on, during the actual production phase. This increases the risk of building mistakes and delays, and leaves little opportunity to establish relationships, or try new working methods and/or materials. Also, as was just seen in the last section, labour contracts for construction workers get a rather high score and are thus considered a very important issue to tackle in the industry. A fourth identified barrier is *insufficient profitability*, which implies that the two most important components for both organizational and technical development——time and financial resources——are seen as missing. The time aspect is also mentioned in conjunction with another identified obstacle, namely that there is insufficient time for development as the companies are too busy with other ongoing projects. From a short-term and price-focused perspective, there is little incentive for technological development, as it often requires substantial and long-term investments.

It is interesting to note that neither *decentralized management* (3%), i.e., the local character of the industry, nor *every project is 'unique'* (6%) are perceived as major hindrances to renewal. This means that two of the factors that are often mentioned as flaws of the industry in regard to innovativeness are not considered hindrances to renewal by the industry itself.

## Construction companies engaging in renewal——the importance of network position

One variation we see in the empirical material is that the respondents have different experiences of renewal activities. Some have been highly involved and have perhaps themselves been driving forces, while others probably have done very little or have sometimes even functioned as a hindrance. In order to utilize this variation, we have designed a statistical model where

**Table 8** Potential barriers to renewal

| Barriers to renewal | Share of respondents stating that there is a considerable hindering effect on renewal (%) | Share of respondents stating that there is a slight or a considerable hindering effect on renewal (%) |
|---|---|---|
| Focus on price in all parts of the supply chain | 39 | 78 |
| Too little time between ordering and starting the project | 31 | 71 |
| Labour contracts for construction workers | 24 | 54 |
| Insufficient profitability | 20 | 63 |
| The business cycle of the industry with quick shifts from boom to decline | 15 | 57 |
| No time—busy with ongoing projects | 14 | 53 |
| The competence level in the industry | 8 | 39 |
| Every project is 'unique' | 6 | 28 |
| How sharing of experience across projects is handled | 5 | 24 |
| The structure of the industry with a few big actors and many small companies | 4 | 20 |
| Decentralized management | 3 | 13 |
| Labour contracts for office workers | 1 | 4 |

the degree of perceived renewal is linked to different potentially influential factors. In practice, this meant that we tested the covariance between particular questions about renewal, potential driving forces and hindrances, as well as the network position. This was done by using confirmatory structural equation modelling in LISREL.[1] The model was based on renewal (R) as a function of network position (N), driving forces (D) and hindrances (H) in the following manner:

$$R = coeff^{*}N + coeff^{*}D + coeff^{*}H \quad (1)$$

By using this model we targeted:

(1) How the degree of renewal is related to the importance of driving and hindering factors—how managers in companies with different degrees of renewal perceived the influencing factors.
(2) How different single dimensions are related to each other and how they together constitute the latent variables.

This means that the model is not designed to demonstrate which type of renewal has been the most frequent in the industry, or which type of driving force or hindrance is considered most common (this has already been presented above). Rather, it measures the *variation* of perceived driving forces and hindrances among the companies in relation to how they have scored on the *renewal* dimension. This means that if a variable (e.g. a potential hindrance) is considered equally important by companies that engage in renewal as by those who don't, it will not have a high impact in the model. However, if a variable is considered very important by the companies that engage in renewal, it will have a high impact in the model and thus affect the latent variable of *renewal*. As such, the results of the model demonstrate the differences between the types of renewal, and also between the perceived driving and hindering forces experienced by those companies that are engaged in renewal to varying degrees.

It is also important to emphasize that what has been measured in the survey, and thus in our model, is the managers' conceptions of these different enabling or hindering factors, and not their *actual* effect. We can thus only say something about what are *perceived* as motivations and impediments of renewal by the respondents. The model discloses which enabling factors, hindrances, or network effects

have the most significant impact (at least in terms of the managers' opinions); it also reveals the degree to which these three influencing factors matter in and of themselves. Here, these results are compared and discussed in reference to the more general results of the survey, as presented earlier.

By using the renewal model to examine the companies that have carried out more substantial organizational and technological development during the last five years, several interesting results appear, of which two are shown in Table 9.

First, RMSEA (Root Mean Square Error of Approximation) is 0.071, which equals an 'approximate fit' of the model.[2] The fairly high $R^2$ value of 0.71 means that the equation accounts for a large part of the variation in the latent variable of *renewal*. All variables of the equation are also statistically significant, except for the variable representing driving forces, which means that this variable doesn't have a statistically assured coefficient. In turn, this suggests that there is little systematic variation in the data of how the variables representing driving forces are perceived by respondents in relation to renewal. Put differently, regardless of whether the company is renewed or not, the managers still think that the same type of driving forces are important. *Network position* and *hindrances* are statistically significant, which means that for these latent variables there is a significant difference between renewed and not-renewed companies, in terms of their network position and their managers' perceptions of hindrances to renewal.

$$R = 0.69^{*}N + 0.24^{*}D + 0.073^{*}H \quad (2)$$

As can be observed in the resulting equation above, the model shows that the strongest variation with regard to renewal is connected to the network position of the company, which means that in comparison to conditions identified as potential driving forces or hindrances, the general network position of the companies has the most significant impact on their renewal.[3] The two most important factors determining the network position in the analysis are whether the company is an independent firm or a unit within a larger company, and the size of the company/business unit in terms of the number of employees. The educational level of the staff and the level of international purchases are also significant. More specifically, the model demonstrates that the companies/units that have engaged in renewal are generally units within larger companies, have a larger and more educated staff, and on average a higher degree of international purchases.[4] This shows the impact of both the internal and external networks; it makes a difference if the company has an extensive *internal* network, i.e., other units within the same corporation and a larger staff, as well as an *external* network, which in this case is partly represented by international suppliers.

**Table 9** Properties of the model

| | |
|---|---|
| RMSEA | 0.071 (90% confidence interval: 0.068; 0.073) |
| $R^2$ | 0.71 |

As shown below, the renewal that takes place within these companies concerns both technological and organizational development. The most significant factors in the renewal during the last five years were:[5]

(1) Increased international purchasing of materials/ increased international purchasing of subcontractors.
(2) The development and use of technical platforms.
(3) An increased use of virtual construction models.[6]
(4) More partnering relationships with clients.
(5) Increased use of foreign labour.

The changes listed above concern both the internal *and* external networks of the company. *Increased international purchasing* clearly concerns the companies' external network, in the shape of their relationships with foreign suppliers; as it requires competent staff and investment, not all companies can engage in this type of activity——this is also true for the use of *technical platforms* and *virtual construction models*. *Technical platforms* refer mainly to a standardization of construction elements and materials, which are combined into fixed modules. The different components and prefabricated materials needed to assemble the platforms are delivered by various suppliers, and can be adjusted for the particular purpose of fitting into the module, which suggests that suppliers are highly involved in the development and production of the platforms. Thus, *renewal*, with reference to technical platforms, involves both the *internal* network of the construction company (in terms of the in-house processes of developing and producing the platforms), and the *external* network (in terms of suppliers and customers). The use of new IT tools for planning and project work, such as virtual construction, is meant to eliminate errors that previously weren't discovered until after production, and which thus necessitated improvised solutions, and led to delays. Since IT offers the opportunity of improving planning, its implementation not only affects the relationship between planning and production, but might also positively affect how the company works with its suppliers, subcontractors, consultants/ architects and customers. Just as in the general results of the survey, *partnering relationships with clients* stands

out as an area where renewal has taken place. A closer look reveals that 80% of the units in larger corporations have stated an increase, while this is true for only 55% of the independent companies. Thus, there is an apparent variation in terms of which type of company uses partnering relationships. Lastly, an increased share of foreign labour is also a type of renewal that involves interaction within the external network of the construction company—in this case with foreign employment agencies. It also greatly affects the internal network of the company, as it introduces new staff, new skills and new working methods.

Despite the relationship between *driving forces* and *renewal* not being statistically significant in the model, the driving forces with the highest impact stand in contrast to the survey results, and seem to have a clear connection to the network position of the company. Therefore we find them relevant for discussion. The two factors with the highest impact are:

(1) Visiting ongoing projects within the larger corporation.
(2) Common efforts within the larger corporation.

The results indicate that the variations in the material are largely accounted for by business units belonging to larger corporations. Visiting ongoing projects within the corporation is considered the most important source of learning and knowledge development, and common efforts within the corporation the most important source for inspiration for new solutions. The subsequent driving forces shown by the model are *internal courses* and *further education for employees*, which point to the size and financial resources of the company; these factors scored rather low in the survey in general, particularly *further education*. This suggests that it is the resources made available through the larger corporation that are the main driving forces of renewal, followed by the external network. However, a common factor for almost all companies in the survey is that customers are considered a very important driving force; further, they are considered more important than suppliers and subcontractors, although, as this doesn't represent a variation in relation to the degree of renewal, it is not shown by the model. The subsequent variable nevertheless indicates that suppliers are also involved in the renewal process, even if only indirectly; it concerns practices for sharing experiences after finished projects, which indirectly relates to the relationships with other actors. The last variable for driving forces concerns visiting completed or ongoing customer projects, which once again accentuates the role of the customer in strengthening the learning and renewal efforts of companies.

Just as practices for exchanging knowledge after finished projects are considered a force for renewal, the lack of such practices is seen as a great hindrance to renewal. The most important hindrances shown in the model are:

(1) How exchange of experiences between projects is handled.
(2) That every project is 'unique'.
(3) Too little time between ordering and start of production.

That all projects are 'unique' means that construction companies in most projects need to adjust to new conditions with regard to the product, the production team, and the local environment of the construction site. This 'one-off' nature of projects, for which new teams are constantly formed, and where there are particular local conditions, often limits the applicability of earlier experiences and solutions. As we observed earlier, this is not generally considered a hindrance by the respondents, which means that project organization is perceived as more problematic by those companies engaging in renewal than by those that do not. A third obstacle concerns the relationship with the customer with regard to the shortage of time between the client ordering the project and the start of production. This is connected to the external network of the company, as it becomes difficult to plan purchases, and the need for different products or services. The hindrances to renewal are thus mainly identified in the uniqueness and locality of the projects, and how these are handled in terms of knowledge-sharing between projects, and the lack of time for much-needed planning. It should, however, once again be noted that hindrances, as well as driving forces (as defined in the survey), are shown to only have a minor influence on renewal compared to the company's network position. This suggests that even if there are particular driving and hindering conditions in the construction industry, the key factors for renewal seem to be whether or not the business unit is part of a larger corporation, which underlines the importance of having access to an extended *internal* as well as *external* network.

## Discussion

The analysis of the empirical material gives some interesting suggestions. The first of these is that the majority claim that there has been a renewal that is visible for the customer, even if just over one-third of respondents answered that 'very little or nothing has happened during the last five years'. It means that the

total changes are not general but more related to how single companies work. Still, almost two-thirds have experienced 'some or substantial renewal'. Given that we, during these last few years, have had a severe economic crisis (that has substantially affected the construction industry), we had expected a lower number.

The network model points to the importance of interfaces with others and through our results we gain an insight into three different types of interfaces of construction companies: the one with customers, the one with the suppliers, and the one that exists internally within the company——the internal network. Starting with the customers, a common type of renewal in both the renewal-orientated companies and the others is an increased share of *partnering relationships*; the importance of this relationship with the customer is also revealed in the results for the driving forces of renewal, where customers are seen as one of the most important sources of inspiration for renewal, as well as a central source for learning. This is apparently an important interface for construction companies. Suppliers, on the other hand, are not seen as very important, and score low as a driving force for renewal in both renewal-orientated companies and the others. Also, the CEO interviews confirm that suppliers are generally seen as less important than customers in terms of renewal efforts. Subcontractors are, however, viewed a bit differently, as they provide specialized knowledge and services on-site. This means that, even though construction companies in general are very dependent on suppliers for materials and services (e.g. Dubois and Gadde, 2002), they still do not consider them to be particularly important in renewal activities. In addition, if we look closer into the types of activities that are performed by the more renewal-orientated companies, we find that, apart from partnering with customers, such activities also comprise the use of foreign suppliers/subcontractors, as increased international purchasing was one of the most common types of change for renewal-orientated companies. This suggests that even though this change *depends* on suppliers, the suppliers themselves are not considered a key resource in renewal efforts.

Together with customers, the internal staff is also perceived by the construction companies as the most important driver of renewal. In larger construction companies the development of an internal network consisting of experts and other business units seems to become almost a substitute for an external network and is used as the most important interface for trying new solutions——this was something perceived equally by renewal-orientated companies and the others. However, where we in the results *did* identify some variation for the more renewal-orientated companies, we found additional variables connected to the internal network, such as common efforts within the larger corporation, internal courses, and the sharing of information. This indicates that, whether it is a company that engages in renewal or not, it is largely the extended internal network that is seen as a driving force for renewal, even if this indirectly also involves an external network of customers and suppliers.

Another result that supports the network model's priority of both internal and external interfaces for renewal is that the most significant influencing variable is *network position*. It is more common for units within larger companies to have a high degree of renewal compared to independent companies, which is also interesting in that it goes against the classical notion that innovative behaviour in general is more typical in smaller companies. In the construction industry in Sweden, it seems that renewal is more common in the larger companies than in the smaller ones, and that part of the explanation for this lies in the access to an extended network of actors and resources, both internal and external. Thus, what the results of the analysis show is that significant renewal, such as development of technical platforms or international supplier relationships, is more likely to be done by companies with an extended internal network of different units. This suggests that the existence of an extended internal (and external) network has an effect on renewal.

It also appears that the driving forces of renewal are based on the types of relationship that are endorsed in the industry, and that there are few differences in this regard between those companies that are renewal-orientated and those that are not. This suggests that there is a direct connection between the type of interface which the construction companies have with certain counterparts, and how the particular counterpart is viewed as taking part in renewal of the industry or not. Put differently, the driving forces of renewal, as identified by the construction companies, greatly reflect the nature of the interfaces between the different actors and their resources within the industry; often there are no close ties between construction companies and the supplying companies, which, for instance, makes co-development rare, while ties to customers appear to become closer and also represent renewal.

An issue closely connected to the network challenges of the industry is *project organization*. The results of the survey generally show that most of the renewal which happens relates to project activities and how to improve the situation of being within a temporary (and, in many respects, locally determined) organization. It is about better planning and project work, and how the relationship with the customer is handled. While the driving forces and inter-organizational issues

were seen in the same way by the renewal-orientated companies and the others, project organization and the impediments for renewal, in some respects, divide these categories of companies into two camps. The analysis tells us that project organization is seen as more problematic by those that engage in renewal than by those that generally do not. While the results generally show that hindrances related to profitability issues and the strong focus on price are predominant, the renewal-orientated companies point to obstacles that mainly concern the way construction companies organize their activities. The unique handling of all projects is one important hindering factor, as is how information is (or is not) shared. Finally, the short time between the order and the start of production makes it difficult for construction companies to plan and marshal all collective experience. The view of project organization as problematic is further indicated by the type of renewal that the renewal-orientated companies carry out, and it appears that the uniqueness of projects (in combination with not being able to adequately share experience within the organization), reduces the opportunity to develop more efficient ways of organizing production. By developing and using technical platforms and better planning tools (e.g. BIM), these companies achieve systematic and technical renewal by creating long-term change over several projects through focusing on more standardized solutions. Being larger companies, they appear to want to move away from the 'uniqueness' of projects by creating a more industrialized and consistent type of production. Also, both platforms and virtual construction are important tools to handle customer and supplier relationships.

In many ways, the problems of how construction companies can or cannot engage in renewal appear to reside in the network position, i.e. the way the companies organize their activities and how they interact, which ultimately creates consequences for the type of knowledge that is being exchanged. One way that this is shown in our results is how the smaller construction companies, consisting of one or a few smaller units, generally seem to lack any collective learning. According to our study, the only relationships they have are sporadic ones with customers. Through these relationships they can get some collective processes going, but due to the short-term focus of single projects, they have problems in finding opportunities for long-term, joint learning. They also have a rather limited internal structure, which means that any learning becomes highly individualized. Business units within larger construction companies have a different situation in relation to joint learning, as they have an internal network that facilitates collective learning across projects and units. These internal mechanisms provide business units with increased opportunities of broadening and anchoring the learning. However, even in these cases, there are limitations. There are few examples of collective learning where suppliers and other external parties, except customers, are involved. Thus, an extensive internal network appears to work as a solution to the restricted opportunities for collective learning in the construction network. In addition, even these units identified a lack of organizational learning from what has been practised in various completed projects.

## Conclusions

The purpose of our investigation was to gain further insight into the inter-organizational issues of the construction industry in regard to how they affect renewal. Previous literature on renewal in construction points to several strongly influential features of the industry that dictate its chances of achieving change, such as its project orientation (e.g. Winch, 1998), of acting in a highly regulated context (e.g. Miozzo and Dewick, 2004), as well as handling complex processes (e.g. Gidado, 1996). By conducting our study from an industrial network perspective, we wanted to delve beneath these explanations by focusing on the inter-organizational characteristics of the construction network, and specifically consider the different types of interfaces (between actors, resources and activities) that define how companies work and how renewal can be achieved. In this concluding part, we present our conclusions in relation both to the network aspects of the industry and its project organization, and finally we propose further research into how to capture more aspects in the renewal in which construction companies engage.

From our study we conclude that the network pattern of the construction industry is clearly reflected by how renewal can be, and is, conducted. First, as has been reported before (e.g. Dubois and Gadde, 2002), we find that the customer is generally valued much higher in cooperative efforts than are suppliers. This suggests that the great dependence construction companies place on their suppliers (by basing 60–70% of their total volume on these suppliers' activities) is not matched by an appropriate degree of interaction and co-development between them, which is strongly connected to the achievement of renewal, as well as a more encompassing type of renewal. Thus, by not developing the interaction with the other companies, from which so much of projects' resources come, construction companies are limiting their external learning opportunities, and consequently their chances of renewal.

Second, it is shown in the results that companies that have found compensation for this isolation in their access to an extended internal (and indirectly external) network, are also the companies which can and do engage more in renewal. Larger companies and units within larger corporations can use the internal network of other company units to learn what has happened in similar projects and use existing interfaces with other actors in this network to gain knowledge as well as other resources. It is the access to this extended knowledge base that creates opportunities for learning across the organization.

Third, it is in this type of systematic knowledge organization that we identify development opportunities. Both the renewal-orientated and other companies point to a clear failure to take advantage of and collect the knowledge that has been gained in the different projects, and we see an increased focus on achieving such routines as a good way to increase renewal in the industry. For smaller as well as independent companies, this becomes harder, as there is a lack of other units with which to interact. However, learning across the different projects (which can be treated as different 'units' and actor constellations, i.e. creating time-based networks) and engaging in more long-term interaction with partners is one way to compensate for this.

We also conclude that the project organization——of temporarily engaging in 'unique' tasks, as well as with counterparts——has a clear effect on what type of renewal occurs. The survey results show that the industry focuses on improving mainly organizational aspects of how to organize projects, with better planning of all activities, resources and actors (and especially the relationship with the customer). In addition, our results indicate that the renewal-orientated companies take the attempts of reducing the project 'uniqueness' one step further. Through the development and use of standardized technical solutions, these companies strive for the desired effect of making the production process more consistent. While often identified as a hindrance to renewal, not only in the literature but also by the industry itself, project organization can thus also work as a stimulating force for renewal in terms of calling for a more consistent type of production.

Finally, an insight which we gained during our study, and which we find suitable for further research, concerns the very issue of identifying and grasping the mediating role of construction companies in renewal activities. They obviously handle some new materials and components all the time, but do not necessarily view these as being renewal activities as the activities in themselves are not changing. A great part of their work is related to the coordination of others which includes mediating between suppliers and customers. In these situations it can often be difficult for the construction companies to see part of that as 'new'. Rather, handling new projects, new products or new components becomes part of that which is 'routine'. This is especially the case when the own activities are not changed. What seems to be clear is that the manner in which companies interact within individual projects implies that they do not need to renew their activities in relation to each other in any substantial way, but that they probably passively mediate a lot of changes anyway. Here we need much better ways of identifying different types of renewal activity; how do renewal activities relate to the whole network way of functioning? One possible feature of construction companies in relation to such a discussion is that they probably already function as a channel for renewal (carried out, for instance, by suppliers) more than they renew their own activities. This is certainly a valuable topic for further studies, which could deepen our understanding of renewal in the construction industry.

## Acknowledgements

This research project has been financially supported by the Swedish Construction Federation and the Jan Wallander and Tom Hedelius Foundation. The authors are also grateful for critical but constructive comments and suggestions from two anonymous reviewers.

## Notes

1. Jöreskog and Sörbom (1993).
2. A 'close fit' requires an RMSEA value below 0.05.
3. What might be confusing about the equation is that 'hindrances' show a positive effect on 'renewal', but what this demonstrates is rather the way that the questions were scaled in the survey——high scores on renewal and high scores on hindrances were positively correlated.
4. As might well be suspected, there is a correlation between these four factors. In general, units within big corporations are larger in terms of the number of employees, have a more educated staff, and a higher degree of international purchases.
5. See the Appendix for the values of the different variables in the model.
6. Virtual construction, also often referred to as building information modelling (BIM), is an umbrella term for 3D-modelling programs used for construction design and planning.

## References

Akintoye, A., McIntosh, G. and Fitzgerald, E. (2000) A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing and Supply Management*, **6**, 159–68.

Atkin, B. (1999) *Innovation in the Construction Sector*, Report for the European Council for Construction Research, Development and Innovation, Brussels.

Barlow, J. and Jashapara, A. (1998) Organizational learning and inter-firm 'partnering' in the UK construction industry. *Learning Organization*, **5**(2), 86–98.

Bengtson, A. and Håkansson, H. (2008) An interactive view of innovations: adopting a new timber solution in an old concrete context. *IMP Journal*, **2**(3), 19–35.

Blayse, A.M. and Manley, K. (2004) Key influences on construction innovation. *Construction innovation*, **4**(3), 143–54.

Bresnen, M. and Marshall, N. (2000) Partnering in construction: a critical review of issues, problems and dilemmas. *Construction Management and Economics*, **18**, 229–37.

Bygballe, L. and Ingemansson, M. (2011) Public policy and industry views on innovation in construction. *IMP Journal*, **5**(2), 157–71.

Bygballe, L., Jahre, M. and Swärd, A. (2010) Partnering relationships in construction: a literature review. *Journal of Purchasing and Supply Management*, **16**, 239–53.

Dainty, A., Briscoe, G. and Millet, S. (2001) New perspectives on construction supply chain integration. *Supply Chain Management: An International Journal*, **6**(4), 163–73.

Dubois, A. and Gadde, L.-E. (2002) The construction industry as a loosely coupled system: implications for productivity and innovation. *Construction Management and Economics*, **20**(7), 621–32.

Egan, J.S. (1998) *Rethinking Construction*, Construction Task Force Report for Department of the Environment, Transport and the Regions, HMSO, London.

Fagerberg, J. (2004) Innovation—a guide to the literature, in Fagerberg, J., Mowery, D. and Nelson, R. (eds) *Handbook of Innovation*, Oxford University Press, New York, 1–26.

Gadde, L.-E. and Dubois, A. (2010) Partnering in the construction industry—problems and opportunities. *Journal of Purchasing and Supply Management*, **16**, 254–63.

Gann, D. (2000) *Building Innovation: Complex Constructs in a Changing World*, Thomas Telford, London.

Gidado, K.I. (1996) Project complexity: the focal point of construction production planning. *Construction Management and Economics*, **14**, 213–25.

Håkansson, H. ed. (1982) *International Marketing and Purchasing of Industrial Goods*, Wiley, Chichester.

Håkansson, H. and Johanson, J. (1992) A model of industrial networks, in Axelsson, B. and Easton, G. (eds) *Industrial Networks: A New View of Reality*, Routledge, London, 28–34.

Håkansson, H., Ford, D., Gadde, L.-E., Snehota, I. and Waluszewski, A. (2009) *Business in Networks*, Wiley, Chichester.

Håkansson, H. and Snehota, I. (1995) *Developing Relationships in Business Networks*, Routledge, London.

Henders, B. (1992) Position in industrial networks: marketing newsprint in the UK, PhD dissertation, Department of Business Studies, Uppsala University.

Ingemansson, M. and Waluszewski, A. (2009) Success in science and burden in business: on the difficult relationship between science as a developing setting and business as a producer-user setting. *IMP Journal*, **3**(2), 20–56.

Johanson, J. and Mattsson, L.-G. (1992) Network positions and strategic actions: an analytical framework, in Axelsson, B. and Easton, G. (eds) *Industrial Networks: A New View of Reality*, Routledge, London, pp. 205–217.

Jöreskog, K. and Sörbom, D. (1993) *LISREL 8: Structural Equation Modelling with the SIMPLIS Command Language*, Scientific Software International, Lincolnwood, IL.

Koskela, L. and Vrijhoef, R. (2001) Is the current theory of construction a hindrance to innovation? *Building Research & Information*, **29**(3), 197–207.

Lind, H. and Lundström, S. (2007) *Bostäder på marknadens villkor*, SNS Förlag, Stockholm.

Lind, H. and Lundström, S. (2011) *Hur ett affärsmässigt bostadsföretag agerar*, Department of Real Estate and Construction Management Scientific Report 2011(3), The Royal Institute of Technology, School of Architecture and the Built Environment.

Love, P.E.D., Tse, R.Y.C., Holt, G.D. and Proverbs, D.G. (2002) Transaction costs, learning and alliances. *Journal of Construction Research*, **3**(2), 193–207.

Ministry of Finance (SFD) (2009) *Sega gubbar? En uppföljning av Byggkommissionens betänkande 'Skärpning gubbar!'*, Public investigation by the Swedish Government, SFD no. 6.

Ministry of Social Affairs (SoU) (2002) *Skärpning gubbar! Om konkurrensen, kvaliteten, kostnaderna och kompetensen i byggsektorn*, Public investigation by the Swedish Government, SoU no. 115.

Miozzo, M. and Dewick, P. (2004) *Innovation in Construction: A European Analysis*, Edward Elgar, Cheltenham.

Seaden, G. and Manseau, A. (2001) Public policy and construction innovation. *Building Research & Information*, **29**(3), 182–96.

Slaughter, S. (1993) Builders as sources of construction innovation. *Journal of Construction Engineering and Management*, **119**(3), 532–49.

Swedish Construction Federation (2011) derived from Statistics Sweden, www.bygg.org/verksamhet/fakta–statistik__195 (accessed 30 January 2012).

van de Ven, A.H. and Delbecq, A.L. (1974) A task contingent model of work unit structures. *Administrative Science Quarterly*, **19**, 183–97.

van de Ven, A., Polley, D., Garud, R. and Venkataraman, S. (1999) *The Innovation Journey*, Oxford University Press, New York.

Winch, G. (1998) Zephyrs of creative destruction: understanding the management of innovation in construction. *Building Research & Information*, **26**(4), 268–79.

## Appendix 1

**Table A1** Overview of the final variables in the LISREL model

| Latent variable | Variable | Coefficient (*latent variable) | $R^2$ |
|---|---|---|---|
| Renewal | Renewal in relation to customers | 0.44 | 0.20 |
| Renewal | Partnering relationships with customers | 0.42 | 0.34 |
| Renewal | Share of subcontractors and specialists | 0.16 | 0.063 |
| Renewal | Foreign labour force | 0.38 | 0.31 |
| Renewal | Share of projects involving virtual construction | 0.37 | 0.42 |
| Renewal | Share of prefabricated materials and construction elements | 0.25 | 0.18 |
| Renewal | Standardization through technical platforms | 0.38 | 0.43 |
| Renewal | Planning level of production | 0.27 | 0.17 |
| Renewal | Quality of project work | 0.025 | 0.00093 |
| Renewal | Share of international purchases of materials | 0.46 | 0.51 |
| Renewal | Share of international purchases of subcontractors | 0.37 | 0.42 |
| Network position | Independent/dependent unit | 0.33 | 0.55 |
| Network position | Share of international purchases | 0.97 | 0.23 |
| Network position | Number of employees | 1.46 | 0.50 |
| Network position | Share of employees with a higher education | 0.63 | 0.25 |
| Network position | Where the company is located | –0.19 | 0.046 |
| Driving force | Learning by doing (through mentorship, coaching, instructions) | 0.18 | 0.066 |
| Driving force | Internal courses | 0.50 | 0.33 |
| Driving force | External courses | 0.21 | 0.10 |
| Driving force | Further education at university level | 0.24 | 0.23 |
| Driving force | Exchanging experiences from finished projects | 0.44 | 0.29 |
| Driving force | Courses and meetings arranged by suppliers | 0.17 | 0.07 |
| Driving force | Study visits and discussions at clients' place of business | 0.39 | 0.23 |
| Driving force | Study visits at projects within the same corporation | 0.60 | 0.46 |
| Driving force | Ideas and opinions from clients | 0.23 | 0.21 |
| Driving force | Ideas and opinions from material suppliers | 0.25 | 0.17 |
| Driving force | Ideas and opinions from equipment suppliers | 0.33 | 0.20 |
| Driving force | Ideas and opinions from subcontractors | 0.30 | 0.19 |
| Driving force | Ideas and opinions from technical consultants and architects | 0.25 | 0.14 |
| Driving force | Ideas and opinions from co-workers | 0.19 | 0.17 |
| Driving force | Technical problems requiring a solution | 0.27 | 0.20 |
| Driving force | Courses | 0.20 | 0.11 |
| Driving force | Competition from Swedish construction companies | 0.31 | 0.18 |
| Driving force | Competition from foreign construction companies | 0.42 | 0.21 |
| Driving force | Information from governmental authorities | 0.23 | 0.097 |
| Driving force | Information from research institutions | 0.29 | 0.16 |
| Driving force | Common efforts within the corporation | 0.77 | 0.45 |
| Hindrance | Focus on price in all parts of the supply chain | 0.31 | 0.14 |
| Hindrance | Insufficient profitability | 0.24 | 0.091 |
| Hindrance | No time—busy with ongoing projects | 0.35 | 0.19 |
| Hindrance | Too little time between ordering and starting the project | 0.47 | 0.29 |
| Hindrance | Every project is 'unique' | 0.52 | 0.36 |
| Hindrance | How sharing of experience across projects is handled | 0.53 | 0.40 |
| Hindrance | The competence level in the industry | 0.43 | 0.25 |

(*Continued*)

**Table A1** (*Continued*)

| Latent variable | Variable | Coefficient (*latent variable) | $R^2$ |
|---|---|---|---|
| Hindrance | Decentralized management | 0.38 | 0.24 |
| Hindrance | Labour contracts for office workers | 0.19 | 0.11 |
| Hindrance | Labour contracts for construction workers | 0.45 | 0.19 |
| Hindrance | The business cycle of the industry with quick shifts from boom to decline | 0.34 | 0.18 |
| Hindrance | The structure of the industry with a few big actors and many small companies | 0.32 | 0.15 |