Work-in-progress

THE ORGANIZATIONAL DIMENSION OF CONSTRUCTION INNOVATION

- HOW CONSTRUCTION FIRMS MANAGE LONG-TERM BUSINESS RELATIONSHIPS

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ABSTRACT

Traditionally, the construction sector is not perceived as an innovative industry (e.g. Egan, 1998; Thompson et al., 1998). One often identified reason for this is its project-based character, resulting in a constant forming of 'unique' actor constellations and products (Miozzo & Dewick, 2004). In addition, as 60-70 percent of the total volume of a project commonly adheres from subcontractors and suppliers, construction firms face particular challenges in how they are to organize their supply networks over time (Dubois & Gadde, 2002). However, rather than seeing this as a reason for non-innovativeness we investigate this organizational dimension of construction as a way to be innovative. With the purpose of better understanding how organisational innovation is part of and affects the operations of construction firms, we investigate the practices through which construction firms handle their supply networks to achieve increased efficiency across projects, i.e. how forms of interaction and relationships create benefits within and across projects for construction firms and their counterparts.

By using empirical examples from two of the largest construction firms in the Norwegian and Swedish construction industries respectively, we analyse specific types of interaction patterns and strategies in relation to handling supply networks. These patterns relate to how activities and resources are managed both within and across several projects as a way to achieve consistency over time and effective adaptations.

In the industrial network perspective, firms pursue close and long-term relationships with a few firms in which often-encompassing adaptations are made (Gadde & Håkansson, 1998; Håkansson & Waluszewski, 2002). Many empirical examples of how supply networks are handled however adhere from serial- and process-based type of industries (e.g. automotive) (Harland, Lamming, Zheng, Johnsen, 2001), while the construction industry due to its project character often is seen as an exception and poor at forming long-term relationships. This paper aspires to shed a different light on the matter.

Keywords: construction industry, innovation, long-term relationships, interaction

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INTRODUCTION

Whether the construction industry is innovative or not has been a long debated issue; while studies using standardised measures of innovation (R&D expenditure) keep claiming a low degree of innovation, other more empirically based studies consistently show examples of how construction actors engage in developing new technical solutions and ways of operating. There are however also empirical examples demonstrating that this probably does not happen to the needed extent for the industry to reach the innovation levels of other sectors (e.g. Holmen, Pedersen, Torvatn, 2005; Håkansson & Ingemansson, 2013; Miozzo & Dewick, 2004). One major issue that has been pointed to is that the development of new solutions and learning that take place within projects are commonly not transferred to sequential projects or to the permanent organisation of the respective project actors (e.g. Gann & Salter, 2000). The discontinuity of construction activities are thus pointed to as the main reason for why new solutions and knowledge are not scaled up and turned into "good currency" (Winch, 1998).

This incoherence of technical solutions and knowledge over time has been adhered to two main characteristics of the industry. First, to the very organisation of construction activities; that they are primarily project-based (e.g. Winch, 2003), and second to the tradition of relating to counterparts in certain ways; the supply chain is reported as characterised by adversarial relationships (Dainty, Briscoe, Millet, 2001) and more related through temporary networks than 'permanent' ones (Dubois & Gadde, 2002). A key issue for innovation in construction thus lie in the ways that construction activities, resources and actors are organised and related. It has also specifically been observed that business relationships appear to be a central way for construction actors to capitalise on investments across projects, rather than through technical solutions (Holmen et al., 2005; Crespin-Mazet, et al., forthcoming). There are numerous examples of how construction actors try to find new ways of interrelating, for instance through partnering agreements which are meant to deepen the collaboration between the project actors (e.g. Barlow & Jashapara, 1998; Bresnen & Marshall, 2000; Crespin-Mazet & Ghauri, 2007). However, a recurrent theme is also to use the ways in which actors in other types of industry interact as a role model for how successful business relationships should appear to induce any benefits (e.g. Lean). How business relationships appear in construction, and how they are communicated, might be different.

In this paper, we will investigate ways of interacting as a central way of being innovative within this industry; finding ways of dealing with one of the greatest hindrances to achieving learning and technological innovation - the lack of continuous interaction - should represent major long-term benefits and improved innovativeness. Therefore, organisational innovation in the shape of beneficial ways of interacting over time needs to be investigated carefully. While the concepts of 'temporary' and 'permanent' networks (Dubois & Gadde, 2002) works well from the perspective of how the industry's project-based character affects the couplings between actors, the specific ways in which the actors strategically navigate within and across these types of network is perhaps less understood. Through the following research question, it is these navigation patterns that we aim to investigate: *how do construction firms manage business relationships over time as part of being innovative?*

There are several examples of how construction actors take initiative and engage in interaction across projects, within both IMP and other types of studies. Are these merely unique and rare cases, or do they indicate a pattern, and if so what type of pattern? We will do this by using the literature as well as case studies from both Norway and Sweden to investigate the occurrence of such patterns. We will also try to identify the potential in these patterns in how they possibly can be made more efficient. We will do this by considering three specific dimensions of initiatives for long-term collaboration and their impact on how

construction actors subsequently innovate. First, whether initiative for long-term collaboration can be considered *formal or informal*, second, which *organisational level* the initiative and collaboration is mainly related to – project or firm, and thirdly, the *level of interaction* which the long-term collaboration entails and the adaptations it therefore enables. Level of interaction refers to whether the individual parties relate to several parties – networking - or in single relationships - dyadic collaboration, and to the extension of mutual adaptations.

In the remainder of the paper, we start by outlining an overview of what has been stated about the type of relationships generally applied in the construction industry and some implications for innovation. We end the theoretical part by addressing the three dimensions for analysing initiatives for continuous interaction across projects. Subsequently, we address our method in investigating interactional patterns within and across projects. Then we outline four empirical case studies from Sweden and Norway demonstrating different ways in which construction firms interact and manage business relationships over time as part of increasing the efficiency within and across projects. The cases are then analysed based on the three dimensions of collaboration initiatives: formal/informal, project/firm level, and level of interaction and adaptation. The paper is concluded with a section presenting our main conclusions of what types of interaction patterns seem to appear as an effect of how construction firms try to navigate the project-based business landscape and create more permanent type of network structures. Finally, research and managerial implications are addressed, as well as possible avenues of further research.

THEORY

RELATIONSHIPS IN CONSTRUCTION

As addressed in the introduction, two often pointed-to reasons for why the construction industry is experiencing lack of innovativeness, is its project-based character (e.g. Gann & Salter, 2000; Winch 2003) and the type of business relationships often applied – short-term and at 'arm's length' (e.g. Miozzo & Dewick, 2004; Dubois & Gadde, 2002). Concerning the project-based character, focus has been on how the organisation of production and interaction mainly related to separate projects creates "*discontinuities in the development of knowledge and its transfer within and between firms, and from one project to the next*" (Miozzo & Dewick, 2004:6). Thus, the discontinuity is identified as causing problems for project-related learning to transfer across projects (Holmen et al., 2005; Håkansson & Ingemansson, 2011), which ultimately hinders innovation. However, while the project-based organisation is often blamed as the main reason for why firms have developed a particular way of relating, the arm's length type of relationships are also seen as a type of behaviour in its own right; there is a tradition of using competitive bidding procedures along the supply chain although other purchasing strategies could be applied (Bygballe, Jahre, Swärd, 2010). Dainty et al. (2001) points to this tradition as a problem as it is part of creating hierarchical relationships between the main contractor and the subcontractors in an increasingly fragmented supply chain. This is summarised by Gadde and Dubois (2010: 260) in the following way: "*the characteristics of construction interaction patterns in time and space indicates that prevailing arrangements do not foster favourable conditions for learning and innovation."*

There are however, different initiatives in moving away from these type of relationships as they are identified as causing problems for innovation to occur. One example is *partnering*, which according to Bresnen and Marshall (2000:230) is a type of initiative directly intended to increase the efficiency of the otherwise "inefficient business processes" in construction. As partnering advices close collaboration and shared risk taking between partners through joint decision-making and financial transparency, its purpose is to create benefits through increased

involvement in the relationship. However, there is little consensus on the definition of partnering and there is also a great variation in how it is implemented. Bresnen and Marshall (2000) separate between two main interpretations of the concept; that it is a long-term relationship between two parties that has realised the benefits of not using competitive bidding procedures, or that it is a formal contract purely for individual projects that can create short-term benefits within the single project. Another distinction that has been made is that of 'strategic partnering' and 'project partnering' (Cheng & Li, 2001). Both relate to there being a formal contract while the former stretches several projects and the latter only covers the individual project. This indicates that there are uncertainties concerning *how* this form of collaboration produces benefits; through formal contracts or informal interaction, within single projects or through long-term cooperation across projects?

Through an extensive literature review, Bygballe et al. (2010) conclude that much of the partnering literature focus on the formal agreement in itself, on single projects, and the dyadic relationship between the two formal partners. This is also acknowledged by Crespin-Mazet et al. (forthcoming) which state that little attention has been paid to the informal aspects of partnering and why this procurement mode is chosen for single- as well as repeated projects with the same partners. Placing focus on the informal network of actors rather than the formal dyadic relationship, they suggest that part of the explanation for repeated project partnering with the same partner and related network, is reaping the benefits from earlier adaptations, while also lowering the individual projects' functional challenge.

There are however some central problems of achieving this type of long-term commitment, or "high involvement relationships" (Gadde & Dubois, 2010:256), whether it is through formal partnering or other forms of interaction characterised by adaptations, interdependence and trust. Gadde and Dubois (2010) identify the main issue as allowing production activities to transcend the organisational boundaries of the single firms and projects, i.e. to implement long-term- and high involvement relationships across projects. In this paper, we investigate different ways in which construction actors take initiative for the forming of such relationships with suppliers and customers. The next section addresses the analytical dimensions we will use to evaluate the patterns of such initiatives.

ANALYSING RELATIONSHIPS AND INTERACTION IN CONSTRUCTION

Two of the main findings of the first IMP study was that with their most important counterparts, firms largely engage in informal- rather than formal interaction and do so over long periods of time (Håkansson, 1982; Ford, Gadde, Håkansson, Snehota, 2003). This has subsequently led to a large number of empirical studies investigating the substance of business relationships and the various implications this has for how we may understand the business landscape (e.g. Håkansson, Ford, Gadde, Snehota, Waluszewski, 2009). Long-term relationships based on trust and commitment have been shown to often contain encompassing adaptations and "heavy" economic investments (Håkansson & Waluszewski, 2002) which in turn leads to interdependency. While this has been shown to lead to, and even be a requisite for, collective learning and innovation (e.g. Håkansson & Waluszewski, 2007), it also implies decreased flexibility as the features of resources and activities become locked to a few specific counterparts. According to Gadde and Dubois (2010:257) this is one of the reasons for why construction firms "avoid dependence"; to remain flexible they circumvent becoming locked to a few suppliers and to keep prices down they continue to practice competitive tendering. As a result, few adaptations are made in relation to counterparts, expect for temporary adaptations within projects.

Therefore, in this investigation of initiatives to move away from a low level of commitment and interaction to more high involvement relationships, we focus on three dimensions of such initiatives in terms of relationship characteristics; 1) formal and/or informal interaction, 2) interaction on project- and/or firm level, and 3) the level of interaction in terms of adaptations. The dimension of formal/informal interaction relates to whether there is a formal agreement that obliges the actors to collaborate across projects or if this is based on informal trust and commitment. The dimension of interaction on project/firm level relates to whether the initiative to collaborate across projects is taken on firm level and is unrelated to any specific projects, or if initiatives are taken repeatedly on project level with the result that a pattern of collaboration may occur across projects. The third dimension relates to the degree that the actors are engaging in mutual adaptations and as such allow themselves to become interdependent (or not). The next section outlines our method of engaging in four case studies and using the three dimensions to investigate initiatives for long-term interaction.

METHOD

We have chosen four empirical examples of how construction firms take initiative to collaborate with counterparts across projects, two from Norway and two from Sweden.

The Swedish case studies are part of a larger research effort initiated by the Swedish Construction Federation in 2010 investigating the drivers and barriers of industrial renewal in construction. The research project included a large survey including 400 construction companies followed by semi-structured in-depth interviews with several respondents of the survey (Ingemansson, 2012; Håkansson & Ingemansson, 2011; Håkansson & Ingemansson, 2013), and three in-depth case studies of ongoing construction projects in the Uppsala region, of which two are presented in this paper. The case study presented as "Example 1" is based on 20 interviews performed in 2012 and 2013. The interviews were all with people in managerial positions representing the customer, the construction company, the main subcontractors, the planning consultant and the architect. The case study presented as "Example 2" is based on 10 interviews conducted in 2012 with people in managerial positions representing the construction company, the two customers and the main suppliers and subcontractors. The case studies are also reported in Håkansson, Ingemansson Havenvid, Linné (forthcoming), Crespin-Mazet, Ingemansson Havenvid, Linné (forthcoming), and Hulthén, Ingemansson Havenvid, Linné, Sundquist (forthcoming).

The Norwegian case studies are part of a longitudinal research study of a main contractor, here referred to as *V-contractor*, stretching 10 years. During this period two initiatives for creating a supply network was followed in real-time (Example 3 and Example 4). This initiative was followed by 1) participation in the main contractor's supply network initiatives, 2) approximately 60 semi-structured in-depth interviews with relevant people from the contractor as well as the subcontractors taking part in the initiatives, 3) attending various internal seminars, workshops and field trips (to construction sites), and 4) reading company documents related to the initiative. Several Master's students were also writing theses about the main contractor and were supervised by the authors. The two examples are also reported as more elaborate case descriptions in Holmen, Pedersen, Jansen (2007), and Holmen and Pedersen (2010).

All the case studies are based on an interactive and inter-organizational perspective investigating the way that construction firms take initiative for closer and more long-term forms of collaboration with counterparts. In this paper, the cases have been analysed by the

use of the three dimensions of formal/informal, project/firm level and level of interaction in terms of mutual adaptations.

THE CASES

N-CONTRACTOR SWEDEN

Example 1

The first example is the construction of a clinic designed to deliver proton radiation therapy for cancer patients, which represents a unique type of project and facility as it is the first clinic for proton radiation treatment in the Nordic countries, and one out of only 23 facilities worldwide holding the exact same type of cutting-edge radiation equipment. Based on the tender for its construction and management, that in 2010 was issued by the newly formed municipal organisation (The Municipal Alliance for Advanced Radiotherapy), it was formulated as a partnering project between *N-contractor* (the Uppsala unit) and the developer *Academic Buildings (AB).* The formal partnering agreement between these two main project actors was perceived as a requisite for seeing the project of about one hundred million Euros through. More specifically, due to its unique character of involving high-risk medical and radiation equipment, being represented by a newly formed client organisation, and representing little prior knowledge in terms of earlier projects of a similar character, it was deemed a highly risky and demanding project. Therefore, partnering was implemented with "open books" between the partners as well as joint purchasing of services and materials.

This formal agreement however has a long history in terms of an informal relationship between *N-contractor* in Uppsala and *AB* stretching 15-20 years. Also, the project organisation of the the clinic project, both in the planning and production phases, represent several long-term and interrelated relationships, such as with the planning coordinator, the electricity installation company, the ventilation- and plumbing installation company, and a Latvian frame supplier. *N-contractor* and *AB* handpicked this selection of companies, as well as specific individuals, due to how well their collaboration had worked for several years, and specifically in two prior large projects concerning teaching- and laboratory facilities that *AB* developed for *Uppsala University*.

However, although there was a history of relating close in an informal way, formalising this interactive relationship between *N-contractor* and *AB* through a partnering agreement had several important positive effects on both the two parties and the rest of the project organisation. Although adjusting to new ways of interacting was time- and resource demanding, it meant that *N-contractor*, which in the former two projects had only been involved in the coordination of production, now took on an advisory role in the planning organisation and was part of early decision-making. It also led to new types of meetings involving several of the project actors that due to information sharing had to meet regularly along the construction process. These meetings were also connected to an encompassing implementation of Building Information Modelling (BIM) involving several of the project actors in the different construction phases. Apart from educating the project staff and adjusting the organisation to using BIM, this led to the formulation of a 'BIM manual' of how to work with this type of coordination and communication tool in sequential projects. With the purpose of reaping the benefits of these initial investment, *N-contractor* and *AB* once again joined forces with the same suppliers and individuals in a subsequent partnering project. The project concerns the construction of the new administrative building of *Uppsala University*, and due to the positive effects of collaborating so closely, an increasing part of the project organisation has been involved in the early phases of the project, increasing the interaction among the actors throughout the construction process.

Example 2

The second example is the construction of four housing blocks of 200 apartments in central Uppsala which was finished in 2013. To the Uppsala unit of *N-contractor*, this project was special in the sense that it involved two different customers and two types of apartments – two blocks were built as rental apartments for the public rental company *Uhem*, and two blocks were built as tenant-owned apartments for the internal housing unit of *N-contractor*, *N-contractor Housing*. This meant that the project organisation needed to adjust to different types of customer demands and product features. The project organisation needing to handle this special situation however had a long history of interacting across several projects; the project was the fifth in line of very similar housing projects being built from 2003 in the Uppsala region. These projects all included the same internal production team at *N-contractor* (same site manager and main engineers), the main technical consultant, frame supplier, electricity installation company, ventilation installation company, and plumbing company.

In the prior projects, three of which were partnering projects, *Uhem* had been the sole customer and therefore the project organisation had adjusted its production to the demands of this particular customer. In one of these, the formal partnering agreement not only included *N-contractor* and *Uhem*, but also the architect and the installation companies. Due to the long-term and both informal and formal type of interaction, these companies were well coordinated and knew how to cooperate, particularly in relation to *Uhem* and the requirements for rental apartments. There are several examples of how technical solutions related to both the product and the production process, involving several of the actors, develops across the projects. Working with this well-integrated constellation of actors, as a second customer *N-contractor Housing* learnt about some advantageous solutions for rental apartments that could be transferred to tenant-owned apartments, for instance how to utilise (rental) space in an efficient way. Furthermore, in parallel to the focal project, in 2012 *N-contractor Housing* initiated another similar housing project of 170 apartments in the same area. In this project, *N-contractor Housing* has been the sole customer while the rest of the project organisation has remained the same, with the same individuals in the internal production team of *N-contractor*. One particular technical solution, the design and production process of a bathroom wall, has in this project been further developed through collaboration among the same project actors.

V-CONTRACTOR NORWAY

Example 3

Some years ago, V-contractor started up a strategic process called "Value creation in Collaboration", which focused on value-creating co-operation with customers, suppliers, and between employees and divisions within the firm. As a part of this process, the firm started up a project/initiative called: "Networks with technical sub-contractors", i.e. suppliers of three types of technical services: Electrical services, Ventilation services and Plumbing services. The aim of the project was: *"To develop a method for choosing and organising co-operation partners which will enable the firm to achieve competitive advantages. This should enable the firm to become better at: (1) choosing 'optimal' technical solutions for their customers, (2) handling interfaces among technical subcontracts and (3) utilising advantages stemming from co-operative relationships."*

Based on the aim of the project, V-contractor classified all the suppliers into a catalogue called the "Supplier Library", which contained the current preferred suppliers classified according to the materials they produced and/or the service they delivered, for example timber frames, steel, plumbing services. The Supplier Library contained two to six preferred suppliers within each category. To select the preferred suppliers, the purchasing department discussed each supplier with foremen, site managers, and project managers and selected the suppliers based on the criteria: 1) that the supplier was financially "viable", 2) that the V-contractor had good experiences from working with the supplier in all phases of building projects, and 3) that the supplier was willing to co-operate with V-contractor on several organisational levels.

Since the initiative focused on designing a supply network of technical subcontractors, the subcontractor delivering electrical services, ventilation services and plumbing services were selected. In total, nine suppliers were selected, three for each type of technical subcontract. The selection process, based on interviews, was carried out by a team including; the purchasing manager, project managers, site managers and foremen based on the following criteria: 1) internal matters (i.e. organisation structure, routines, market strategies, focus in technological development), 2) the supplier's co-operation partners, mainly other customers and suppliers, 3) competitors (firms which the suppliers would recommend as co-operation partners), 4) ability and willingness to co-operate with V-contractor, and 5) further plans in relation to V-contractor. V-contractor organised a number of seminars and discussions between people from the selected subcontractors and the contractor. Top management, project managers and foremen from the subcontractors as well as top management, the purchasing manager, project managers, site managers and foremen from V-contractor attended the meetings.

The designed supply network was to be tried out in a number of actual construction projects to create interaction and develop relationships between V-contractor and the subcontractors as well as relationships among the subcontractors. Thus, V-contractor identified a number of construction projects, where the designed supply network was tried out. In these projects the subcontractors were divided in different constellations which were to work together as 'sub-networks' with electricians, plumbers and ventilation installers. In each pilot project the following activities were carried out: 1) a "kick-off" meeting (setting aims and expectations), 2) a mid-term evaluation (filling out evaluation forms and discussing negative and positive experiences), and 3) a final evaluation (same as for mid-term evaluation, but carried out after each of the pilot projects had ended).

Through this process, the way in which V-contractor related to its technical subcontractors changed dramatically. Out of V-contractor's total purchase of technical services in the last year of the initiative, approximately 95 per cent were from the designed supply network. After the chosen construction projects had been carried out, a summary report was made of the supply network initiative. The intention was that the report and the actual experience gained through the initiative would enable maintenance and further development of the supply network over time.

Example 4

For some time, V-contractor had been displeased with the way in which they collaborated with technical subcontractors, i.e subcontractors for ventilation, electrical services and plumbing. Thus, V-contractor started an initiative to develop a small network of technical subcontractors who could 'train as a team' across a number of construction projects which would function as pilot arenas for the collaborative efforts. The motivation for starting the

initiative was to establish mechanisms which could facilitate joint learning and mutual adaptations between V-contractor and their technical subcontractors, and also among the technical subcontractors.

Thus, V-contractor started the process of getting an overview of their present technical subcontractors in order to identify suitable candidates for the initiative. To be able to select the partners for the initiative, V-contractor focused on a lot of different criteria such as: 1) financial situation, 2) goals and visions, 3) organisation, competence and capacity, 4) development processes carried out in the past five years and the result of these, 5) the result of the collaboration with V-contractor so far, 6) the personal chemistry among the individuals from the different firms involved in the relationships to V-contractor, 7) other preferred subcontractors (within the field of ventilation, electrical services and plumbing) to collaborate with etc.

Having singled out five to six technical subcontractors, V-contractor visited the subcontractors to evaluate their ability to partake in the initiative. Based on these meetings, V-contractor chose three subcontractors – covering the respective specialisms of plumbing, ventilation, and electrical services.

After the subcontractors were selected, they established a steering committee for the supply network initiative consisting of the top manager of V-contractor and the top managers from the three subcontractors. Furthermore, an external consultant was recruited into the project. The consultant developed a type of coordinating management tool between different types of employees (project managers, site managers, foremen, etc.) in a construction project. This tool was first implemented internally by V-contractor, and during the initiative V-contractor wished to transfer this tool to the subcontractors, so that it could be used in mutual construction projects. Furthermore, the steering committee (supplemented by other relevant employees from the four firms) developed clear objectives that were to be achieved. These were goals related to (i) the number of accidents at the construction site, (ii) health, safety and environment issues, (iii) tidiness at the site, (iv) absence rate, (v) the amount of unproductive hours at the site, (vi) the number of quality defects, etc. These goals were followed up closely in the joint construction projects. In these projects the personnel from the three subcontractors worked with personnel from V-contractor on actual construction projects, through which it was assumed that the supply network would develop substance. Furthermore, the steering committee established two subgroups (with participants from the four firms) which were to discuss and establish more concrete activities related to the themes ‘development’ and ‘production’. The suggestions from these two groups were also to be tested in the actual construction projects. However, it was difficult for V-contractor to find suitable construction projects to test out the different suggestions both from the development and the production group, thus it was difficult to achieve joint learning and mutual adaptation in the way V-contractor had planned.

DISCUSSION

The interaction patterns that we can observe in the four examples highlight several interesting issues regarding how construction companies manage business relationships as part of being innovative – i.e. trying to move away from the traditional and “arm’s length” ways of interacting.

In Example 1, the interaction between the main contractor and the customer has a very long history and for (at least) four projects (during the investigated period), they also interact

closely with the same subcontractors, planning consultant, and frame supplier. First applying traditional contracting, they then decide to initiative formal partnering due to a high-level risk project which they continue to apply in a subsequent and less risky project.

In Example 2 on the other hand, the interaction between the main contractor, the customers and suppliers alternates between traditional contracting and partnering agreements across the projects (in one project the partnering agreement even includes the architect and the subcontractors). In that sense, it alternates between formal and informal close collaboration – regardless if there is a formal contract or not in the separate projects to collaborate closely, the actors remain the same and continue a tight collaboration across several projects.

In both these cases, the collaboration is project-related in the sense that there is no formal agreement to collaborate across projects but each contract is separate and only connected to the individual project. Examples 3 and 4, on the other hand, illustrate something else. In these cases, there is a formal agreement between the main contractor and the subcontractors to collaborate across several projects as a supply network. There are thus formal agreements with the long-term perspective of working together across projects. These initiatives are clearly taken on the firm level where a network of actors is formed as part of a strategic initiative to integrate different services and solutions across organisations to promote learning and adaptations as well as being able to offer a "package deal" to customers.

While the initiatives for continued collaboration in Example 1 and 2 appear to be part of managing long-term relationships in a strategic but temporary way in relation to separate projects, Examples 3 and 4 illustrate top management initiatives to manage long-term relationships in a more permanent way and thus strategically associate specific actors to its operations and various projects.

Concerning the level of interaction and mutual adaptations, it appears as though Examples 1 and 2 show more encompassing type of adaptations that are re-used and further developed across projects. In Examples 3 and 4, the formal initiatives are partly based on achieving increased learning and adaptations, but while V-contractor mainly uses the subcontractors in the supply network across projects, little adaptation is made in technical and organisational solutions between the actors. This is partly because circumstances made it hard to continue the same constellation and collaboration. For instance, in one of the cases no suitable projects were found to test the ideas and plans of the network in practice. Figure 1 displays the three analysed dimensions of the four initiatives for close collaboration.

	N-contractor Example 1	**N-contractor Example 2**	**V-contractor Example 3**	**V-contractor Example 4**
Formal/Informal	Informal and formal across projects	Informal and formal across projects	Formal across projects	Formal across projects
Project-related/firm-related	Project-related	Project-related	Firm-related	Firm-related
Level of interaction	Networking with several organisational adaptations and some technical development	Networking with several technical adaptations and development	Networking with little adaptation	Networking with little adaptation

Figure 1. The three dimensions of initiatives for long-term collaboration.

CONCLUSIONS

Through the different empirical examples, we have shown that, when possible, construction actors take initiative to interact over time and across projects if there is trust and commitment to build on (accompanied by technical adaptations although this is sometimes harder to achieve). These examples cover standardised projects as well as one-off type of projects, which means that interaction *within* projects with actors that construction firms have been working with *across* projects, is often the preferred cooperation mode in projects.

The examples also show that in the Swedish cases (Example 1 and 2) the interaction starts in a single construction project but are followed up in the next projects where many of the same actors are taking part. Thus, in both the Swedish examples they are able to carry out construction projects as 'pearls on a string', and the actors involved can bring with them a tacit knowledge that can be reused and further developed in the following project. In the Norwegian examples (3 and 4) they have planned for testing out the cooperative way of working together in construction projects following each other as 'pearls on a string' over time, but are to a less extent able to carry out this plan due to changes in the supply network in the first examples and lack of construction projects in the second. Thus, they are not (or to a less extent) able reuse their knowledge in another construction project.

Furthermore, even though the examples differs when it comes to formal versus informal collaboration and also with regard to a project related versus a firm related focus, all the examples show genuine desire to build and develop relationships with high degree of involvement. Thus, a lot of interaction takes place between the different cooperative actors in the cases that we have studied. We found that interaction has taken place on the specific construction projects independent of the project being part of a formal and planned cooperating initiative or not. So the interaction in a single project is important and interesting is itself, but even more as a starting point for cooperation and continuous interaction across project and firm boundaries.

Bringing about organizational, relational innovation in construction involves working together on a number of projects which ideally should occur as "pearls on a string", as mentioned by several of the construction actors. The actors may have an intention, or plan to join many thin strands of interaction into a stronger string of collaboration. However, the actors also have to be "finders of pearls", i.e. projects on which it proves possible for the actors to work together and, in turn, strengthen their collaborative strings. If they do not succeed in finding pearls, or farming some themselves, the opportunity to bring together the strands is missed and may start to split, despite their intentions or plans.

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