

HOW TO MAKE USE OF INTERDEPENDENCIES IN A FRAGMENTED BUSINESS LANDSCAPE – INFORMATION GATHERING IN CONSTRUCTION PROJECTS

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INTRODUCTION

The construction industry presents itself as the extreme case of a fragmented business network in terms of representing a high degree of specialisation and the major part of all activities being confined to temporary projects (Håkansson et al., 2016; Winch, 2010). The high degree of subcontracting implies that firms need to mobilise a number of others to acquire the resource base needed to carry out the construction project. However, while firms in this way are highly dependent on each other, business interaction is often confined to short and intense periods of separate projects (e.g. Dubois and Gadde, 2000). As such, the construction industry has been referred to as a “loosely coupled system” (Dubois and Gadde, 2002). There is also a tradition of using competitive tendering rather than collaborative procurement strategies (Eriksson, 2015), which further contributes to the competitive and short-term perspective on inter-organisational dealings. Therefore, if use of relationships over time can be shown within such an “inhospitable” environment, they must be an important phenomenon.

Earlier studies of renewal in this industry have indicated that relationships and the network context matter for both learning (Håkansson et al., 1999) and innovation (Holmen et al., 2005; Havenvid et al., 2016a; Havenvid et al., 2016b). It has also been indicated that when possible, construction firms and managers try to build “bridges” to earlier projects in order to re-use and further develop earlier learnings and solutions (Havenvid, et al., forthcoming 2019). However, while there has been indications that relationships across projects can function as carriers of knowledge, there is to date few studies that systematically have traced how construction firms and managers more specifically go about to gather information and knowledge that is available in the internal and external networks of project actors to carry out an innovative type of project (one example of an exception is Veshosky (1998)).

With the ambition to trace patterns of information gathering of construction firms in such projects, the authors have thus far studied two innovative construction projects in the Norwegian context. Both represent innovative projects as they are new facilities built specifically for psychiatric care and part of a larger national initiative of upgrading psychiatric health care, an unprecedented occurrence in the history of Norwegian construction and health care. As such, the resulting buildings consist of many specially adapted solutions and products that the construction-related organisations (firms and public actors) have not been used to handling. As a consequence, the involved project actors have been required to reach out to different information and knowledge sources in order to complete the project missions.

Through a total of 26 semi-structured interviews across the two sequential projects, the authors have mapped how key actors have been gathering information and developed specially adapted solutions for the sake of the specific projects. A resulting model revealing the project actors' pattern of information gathering shows that there is a central public actor (the advising developer) coordinating both research-based knowledge and knowledge in the external and internal network of actors. However, the other actors have their own ways of extracting and developing knowledge and solutions through their own internal and external networks. Some actors rely solely on their internal networks while the external network is crucial for others. This brings interesting insights on information gathering practices by construction firms, as an example of how interdependencies are and need to be used also in such fragmented type of business networks.

The remainder of the paper is structured as follows. First we outline our theoretical standpoint regarding learning and innovation from an IMP perspective and present earlier insights on this topic within the construction management literature. We provide our methodological considerations and then we present the results of the study. In the analysis, we classify the type of information gathered, how it was retrieved and by whom. We end the paper with our main conclusion of the findings so far, and propose further research.

THEORY

This paper deals with how organisations seek and acquire information to develop new knowledge, solutions and products for a specific user purpose. From an IMP perspective, the interdependency among firms prompts them to interact in order to sustain and develop their business (Håkansson et al., 2009). One of the main findings of the early IMP studies, and basic tenets of the IMP perspective, is that this interaction entails technical, organisational and social adaptations which interconnects firms in several ways (Håkansson, 1982). This interaction also entails exchange of information, learning and in some cases new knowledge development (e.g. Håkansson and Waluszewski, 2007; Bygballe, 2006). For instance, it has been shown that different forms of interaction results in different forms of knowledge (Håkansson and Prenekert, 2004; Cantillon, 2010; Håkansson and Ingemansson, 2011), thus showing the relation between interaction and knowledge exchange and development. While one-off transactions provide no or extremely limited opportunities for learning, close cooperation on a long-term basis presents good prospects of engaging in substantial learning and even develop new knowledge. Basically, this shows that interaction is a basic condition for inter-firm knowledge exchange and development.

In IMP, innovation is often described as new *resource combinations* which signifies using or combining existing bodies of knowledge in new ways (Håkansson and Waluszewski, 2007). For the present study, this has three important consequences. Firstly, no actor possess all the necessary information or knowledge to engage in innovation, rather firms need to seek and use information and knowledge of others (Håkansson and Waluszewski, 2007). Secondly, innovation arise at the interface of different bodies of knowledge, thus in the development of new solutions different sources of information and knowledge need to be sought and used. Thirdly, *how* actors go about to seek and use information is a result of the context in which they operate. Thus, in considering information gathering behaviour, the context in which this takes place must be taken into consideration. In essence, when developing new solutions and engaging in innovation processes, firms need to seek and use information that is dispersed across several firms.

In the construction management literature, the interactive nature of learning and innovation has been acknowledged by several scholars. For instance, Harty (2008) introduced the concept of *relative boundedness* to state the distributed nature of learning and innovation in terms of being a process not controlled by any one actor but involving several actors through which its effects spread in unpredictable ways. Investigating how and why the effects of renewal efforts spread in particular ways means taking the specific temporal and spatial boundaries into consideration (Havenvid et al., forthcoming 2019). Several studies have pointed to the lack of long-term relationships and interaction over time as a reason for project-based inventions not being scaled up to become innovations (e.g. Miozzo and Dewick, 2004; Dubois and Gadde, 2002; Winch, 2010). However, settling at such explanations may discourage further investigation into how construction-related organisations engage in information gathering and problem-solving as part of trying to work in new ways and come up with new solutions. Rather, we need to further investigate *how* they interact and exchange information at attempts of innovation.

Bossink (2004) point to knowledge exchange as an essential driver of innovation in this industry of which effective information gathering is an important activity. Through a literature review, this author finds three highly relevant studies for the present study. Firstly, in an investigation of project managers' information-seeking behaviour in engineering and construction firms, Veshosky (1998) found that one important difference between just keeping up to date with current developments compared to problem-solving was that when solving problems and coming up with new solutions, external sources of information and knowledge, such as conversations with clients, vendors, and external colleagues, were reported as relatively more important. Secondly, Toole (1998) found that a firm's innovativeness was related to its ability to gather and process information about new technology, and that by communicating with external actors such as material suppliers and retailers, designers and contractors reduced their uncertainties about new possibilities and solutions. Thirdly, by studying innovation in offshore construction in the UK, Barlow (2001) concluded that innovation is facilitated by internal and external communication structures defined in a non-hierarchical way, and that construction projects characterised by lateral communication enables knowledge exchange and encourages innovative solutions.

In this paper we wish to further investigate the information gathering behaviour and practices of construction-related firms and organisations with the purpose of deepening our understanding of how organisations learn and innovate in a fragmented type of business setting.

METHOD

Methodologically, the authors have chosen a case approach. This is appropriate for this type of exploratory studies (Yin, 1994). To find reasonable cases, the authors decided to use theoretical sampling. We have looked to an industry where relationships are less common than elsewhere, namely the construction industry. Many scholars have pointed out that the construction industry relies much more on arms-lengths bidding processes than for example the manufacturing industry (Dainty et al., 2001; Bygballe, et al., 2010). Thus, the authors reasoned that if we can find evidence of use of relationships even in such an industry, the reasons for using relationships for certain purposes must be strong. Also, since we are looking for radical inventions, we have picked a specific type of the construction industry, namely the construction of psychiatric ward buildings. These buildings are seldom built, and contain a number of unique solutions that needs to be constructed specifically for the project at hand.

Thus, this kind of construction project requires participants in the project to develop and use radical solutions; solutions that they are unlikely to need in later projects.

As mentioned above, as the empirical data for this article we rely on interviews made within two construction projects. Both of them concerned psychiatric ward buildings, one larger project and another rather small project. Both projects were new constructions with up-to-date or ground-breaking equipment. When choosing interviewees, we paid particular interest to actors that had been responsible for engineering and/or construction of specially adapted products. Through a total of 26 semi-structured interviews with involved actors and divided evenly between the two projects, the authors have gathered data on how the actors have been involved in accomplishing information search and adaptation work. The questions were developed with the purpose of identifying new solutions in terms of new *resource combinations* and how the various actors had gone about developing them. Some actors were interviewed several times. The actors that have been interviewed more than once are Sykehusbygg (the advising developer) which was involved in both of the projects (a total of five interviews), and for the two contractors, two and three interviews have been conducted respectively (see Table 1).

Analytically, we have divided the involved actors into broader groups of actors by their role in the construction project. We have then registered every expression related to the individual actors' acquisition of information or knowledge about specialised solutions which may or may not be inside their own organization (other firms, other projects etc.) and systematized these data.

Type of actor	Number of actors in each group	Number of interviews
Sykehusbygg	1	5
Contractor	2	5 (2+3)
Subcontractor	5	5
Architect	2	2
Supplier	5	5
Advisor/Consultant	2	2
User groups	2	2
Total	18	26

Table 1. The interviewed actor groups and the number of interviews.

Case descriptions

Both cases concern the construction of psychiatric wards. Such specialized buildings have not been constructed in Norway since the late 60's, and as such, none of the actors involved had actual experience with this type of buildings. Case 1 was the first project carried out between 2015 to late 2017. It was one building consisting of zones ranging from heavy psychiatric patients to day patients. The total contract was around 245 million NOK. Case 2 was initiated later in 2015 and finished in late 2018, and consisted of a much smaller building added to a local hospital as well as refurbishment. The new building and the refurbishment was designed for general psychiatric care and drug abuse. The total contract in this case was 192 million

NOK (the new building 128 million NOK). An important observation in the case is that the actors in Project 2 had knowledge about Project 1, even though few of them had actually taken part in Project 1. Another important issue about the cases is that one actor, *Sykehusbygg*, plays a crucial role in both cases. This actor is a government-owned corporation who is tasked with coordinating and supporting all construction projects in the health sector in Norway. As an advising developer representing the client (the hospitals) in each project, it is taking an active part in the projects, often in a coordinating role. However, it is also commissioned to act as a knowledge center that collects, develops and spreads knowledge and practices regarding health care construction. This is should both perform and share research about construction in the health care sector. As such, in Norway the project ownership and management of health care construction has become centralized with the purpose of gathering the knowledge and competence of how to build health are facilities in one organization. This is mean to result in more efficient construction projects and more effective health care facilities. We will get back to the important and very interesting role of this actor after we have presented the empirical findings. Finally, involvement of users, i.e. representatives of patients and staff, was considered crucial to succeed with the project mission and therefore user groups were active participants in both projects.

RESULTS

A figure has been developed that shows where the different actors reach out to obtain knowledge about specialised products and solutions. The individual organisations have been divided into broader groups of actors by their role in the construction project. For each of the group of actors, a certain pattern has been recognised with regards to where that actor reaches out to get information or gain knowledge about a specialised product or solution. The results are shown in the model in Figure 1. On the left we find all the actors, and on the right we find different sources of information and knowledge. An arrow between two actors or between an actor and a source of information/knowledge indicates where that actor has reached out to gain the information/knowledge. A summary explaining Figure 1 follows below.

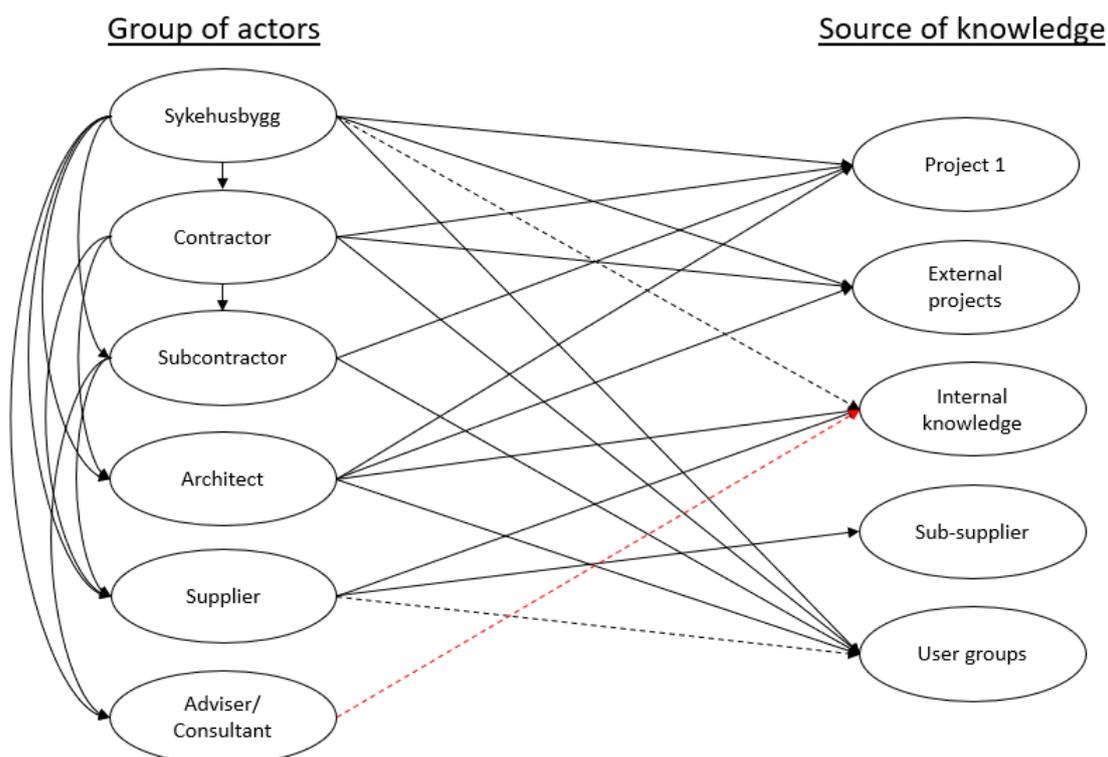


Figure 1. Location for information gathering among the project actors within both Project A and B.

From the interviews it is clear that Sykehusbygg mainly has a coordinating role and mostly reaches out to the other actors in the network in order to find solutions for the specialised products and solutions. As Sykehusbygg is a public actor representing the hospitals, their role is very much concerned with making demands that are in line with the special needs of the specific psychiatric wards. These demands are highly influenced by external projects they have been in contact with or visited, as well as their interaction with the user groups (i.e. representatives of patients and staff). The user groups include representatives from the hospitals that have provided their knowledge about what special products and solutions are needed. The demands are summarised in an “Experience Matrix” which include all the needs that must be fulfilled by the contractor. Consequently, the users seem to communicate more with the contractor compared to the other actors.

Sykehusbygg does not develop the specialised products and solutions themselves, but they organise meetings and facilitate the development of the specialised products and solutions from the other actors in the network. One way of doing this, which was identified in the Project B, is through meetings referred to as “product presentations” where the different actors present the actual product (e.g. a door) to Sykehusbygg and the user representative in order for all the involved parties to agree on the best solution. These meetings have provided a way of communication on what is needed and how it needs to be designed and incorporated into the building.

Another striking result is that Sykehusbygg has served a role of transferring a lot of knowledge from the first construction project to the second. From the actors that have been interviewed, Sykehusbygg is the only actor which has been involved in both of the construction projects, and they have therefore played a very important role in transferring information and knowledge about the first project (1) to the actors participating in the second project (2). Finally, Sykehusbygg has a lot of experience in building hospitals in general, but this is not directly linked to the specialised products and solutions in these two projects, therefore a dashed line is drawn between Sykehusbygg and “internal knowledge”.

The second group of actors are the contractors. They receive the demands for the project mainly from Sykehusbygg and needs to fulfil these in order to complete the contract. The contractor also plays a type of coordinating role, and they mainly reach out to their partners in the project to develop specialised solutions. In addition they have been invited to join Sykehusbygg in visiting external hospitals/projects to gain inspiration for solutions. Especially the second project (2) has gained a lot of inspiration from the first project (1). Finally, the contractors have also been involved with the user groups and led the “product presentations”.

The third group of actors are the subcontractors. The interviews show a very clear pattern here. Based on the demands they get from Sykehusbygg and their contractor, they are the ones that need to develop the actual solutions, and all the subcontractors go to their suppliers to find or create the specific products and solutions. Also, for the second project (2), they have gotten a lot of inspiration from the first project (1). Finally, some of them have been in contact with the user groups (e.g. through product presentations), which has served as inspiration for in turn setting the demands for their suppliers to develop the specialised products and solutions.

The fourth group of actors are the architects. This group seem to mostly gather knowledge from previous experience in other projects as well as from external projects. The second project (2) has also been very much influenced by the first project (1). Other projects has definitely been the main source of knowledge for the architects. In addition the contact with the user groups has been important for them. Also, in the second project (2), the architectural firm used experiences and staff from their Swedish office specialising in health care architecture.

The fifth group of actors are the suppliers, and the most obvious pattern here is that they all seem to use their internal knowledge and experience in order to develop the specialised products and solutions themselves (or within their supply chain). Some of them have been in touch with the user groups, but the information and demands from the users are mainly communicated through the contractors and subcontractors. Some of the suppliers reach out to sub-suppliers for components contributing to the solutions.

The sixth group of actors are the advisers/consultants. These actors follow instructions and try to satisfy the demands from Sykehusbygg, and their internal knowledge seems to be the main source for finding solutions. However, it is not possible to conclude on this from the two interviews, and the line between the adviser/consultant is therefore marked in red. This is therefore a source of further research.

Finally, the last group of actors are the user groups. This group has mostly been involved with setting demands and approving solutions, and has therefore not been involved with actually developing the products and solutions. These actors are therefore placed at the right column of the model together with the other sources of knowledge.

DISCUSSION

It is clear that most of the actors reach out to different sources of information and knowledge in order to develop the specific solutions needed for the projects. While Figure 1 is based on interviews from both of the studied construction projects, in the following discussion we will explore whether there are any differences between the two projects. The matrices in Figure 2 and 3 try to illustrate whether such differences exist or not. The advisers/consultants have been excluded from the matrices due to inconclusive results, and as the users are mainly a source of knowledge and do not reach out for knowledge themselves this group \has also been excluded from the matrices. The actors relevant for this discussion are therefore (1) Sykehusbygg, (2) Contractor, (3) Subcontractor, (4) Architect and (5) Supplier. The actors are represented by the corresponding numbers in the matrices below.

The first matrix maps whether the actors reach out to gain knowledge internally in their company or externally for Project 1 and Project 2. As can be seen from the matrix, all the different actors stick to the same pattern across the two projects of where they reach out to gain knowledge, except (1) Sykehusbygg which in Project 1 mainly sought for external knowledge but then primarily used internal knowledge for Project 2. A likely explanation is that Sykehusbygg gained a lot of knowledge about building psychiatric wards in the first project which then was used for Project 2. Concerning the other four actors it is evident that (4) Architects and (5) Suppliers mainly use their internal knowledge, whereas (2) contractors seem to mostly reach outside their company to gain knowledge. This makes sense as the contractor mainly has played a coordinating role and therefore reaches out of their company

to gain knowledge. Lastly, the (3) Subcontractors seem to combine internal and external knowledge when developing the specialised solutions for the project. For those who seek external knowledge, it is also interesting to explore whether they seek this information from inside or outside their established supply chain. It was found that (1) Sykehusbygg mainly reached outside of their supply chain (external projects etc.), whereas (2) Contractors and (3) Subcontractors mainly reached to other actors inside their supply chain to gain knowledge. This result most likely implies that the (2) Contractors go to their (3) Sub-contractors, and the (3) Sub-contractors mainly go to their (5) Suppliers for knowledge. In this way they stay within the supply chain when seeking external knowledge.

	Project 1	Project 2
Internal knowledge	4 5	1 4 5
	3	3
External knowledge	1 2	2

Figure 2. Matrix indicating if the actors search for and use mainly internal or external knowledge in Project 1 and 2 respectively.

The second matrix in Figure 3 shows whether the actors use inspiration from external projects in order to develop specialised solutions, or if they simply develop the solutions “themselves”. (1) Sykehusbygg and (2) Contractors seem to mainly use external projects as their source of knowledge for both projects. For the other three actors, one can find differences between the two projects. The (4) Architect in the first project used some inspiration from other projects combined with developing solutions themselves but in the second project they seemed to use mostly inspiration from external projects, as well as colleagues from the internal network abroad. Also the (5) Suppliers used a slightly different information gathering behaviour between the two projects. In the first project they mostly relied on developing solutions themselves, while in the second they also gained some inspiration from external projects. The most striking result from this matrix, however, is that the (3) Subcontractors only relied on developing solutions themselves in the first project, whereas in the second project they used a lot of inspiration from external projects.

	Project 1	Project 2
External projects	1 2	1 2 3 4
	4	5
Develop yourself	3 5	

Figure 3. Matrix indicating if the actors search for and use knowledge mainly from external projects or from external projects in Project 1 and 2 respectively.

A possible reason for the change in using external projects as inspiration vs developing solutions inside the organisation is the fact that Sykehusbygg has been part of both projects

and therefore served as a role in transferring the knowledge from the first project to the second project. Also, most of the actors involved in the second project had been invited to observe and inspect the results of the first project. The solutions developed by actors (3)-(5) in the second are therefore most likely highly inspired by the first project.

CONCLUSIONS

The main theme for this article is to get some empirical data from real cases on where different actor groups get information about innovative solutions that are new to them and on products they have not used before, at least not in the same context. What we would expect from interactive network theory is that they use contacts with other actors in their network to find these solutions and negotiate how to apply them in the specific setting. This has not surprisingly been confirmed in this study. Actors do indeed search out other actors within or outside of their network who they think may have the needed knowledge, and then try to apply this knowledge to the problem at hand. However, our study allows us to be more specific about *where* different actor groups in a construction project goes in order to find such knowledge. As we have shown in the discussion, certain actor groups, such as contractors and architects tend to go outside of the supply chain to look for solutions, whereas others, particularly suppliers, tend to stay within the supply chain and often turns to their sub-suppliers for such knowledge. Sub-contractors tend to search both inside of the supply chain and outside of it, depending on specific circumstances. In our study, two cases are not enough to say exactly which circumstances are important for this decision. However, the results indicate that there are different patterns in regard to how firms use interdependencies, such as relationships, in order to gain knowledge of how to develop new solutions. This means that within the total project network there is a mix of using established relationships for gaining such knowledge and going to external knowledge sources not related to particular relationships.

In our study, there are also two particular circumstances that seems to affect our conclusions. One of them is the presence of the actor called Sykehusbygg. This is a public actor with the mission of coordinating and advising all construction projects in the public health care sector – a centralized developer and spreader of knowledge. Their presence is very strong in our study, and particularly in the second case (Project 2), where they are the only actor with experience from the construction of the first project and thus have a lot of relevant knowledge to share. On the other hand, our empirical evidence also hints that involvement of Sykehusbygg as an actor is a presence that increases cost, both direct costs associated with the time and resources they use themselves, but also indirectly in the sense that the construction projects where they are involved have more meetings and more administrative costs. To follow up on the role of this particular actor could be an interesting way of developing this research, and to compare these cases with similar cases in other countries where such an actor as Sykehusbygg does not exist would be a natural next step for our research.

The other important circumstance in this case material is the fact that we have studied two projects that closely follow each other in time. The impact of the first project on the second one is apparently large. Where the first project had to discover a lot of new solutions on their own, the second project could draw heavily on the first project's experience. This partly meant that some solutions that were new in the first project and had to be specifically developed by the actors involved, could be used almost directly in the second project, thus reducing the number of innovative solutions required for the actors involved in that project. Also, some negative experiences from the first project with solutions who didn't work well or were more costly than originally thought, could be avoided in the second project. This is an example of actively building "bridges" between projects (Havenvid et al., forthcoming, 2019). Finally, as mentioned above, the timeline meant that Sykehusbygg as a common actor in the two projects could fulfil the role as a coordinating actor with more knowledge and thus more weight than they had in the first project.

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