# Policy and industry views of innovation in construction


## Abstract

During the last decades, the construction industry has been a political target for not being sufficiently innovative. At the same time, public funding to construction-related research and development (R&D) has decreased in several countries, which indicates a shift in terms of state involvement in the construction industry as well as the housing situation.

This paper investigates policy and industry views of construction innovation, and compares these views with recent theoretical conceptions of innovation based on a network perspective. The study draws on a review of government documents on construction R&D funding, public statistics, surveys and CEO interviews in both the Swedish and Norwegian construction industry. The findings reveal that the governmental bodies facilitating and funding construction R&D and the construction industry itself, display partly different views of innovation, both in terms of what innovation actually means and what spurs innovation in this particular setting. While the policy view, particularly in Sweden, is dominated by the need for more competition, the industry perceives the client as the most important driving force for renewal and innovation, as well as closer collaboration with both customers and suppliers. The industry has, however, as yet failed to establish the required couplings with external sources for renewal, which is attributed to the strong emphasis on price in all parts of the industry. The contribution of the paper is twofold: firstly, it discusses reasons for the different views and their implications for innovation practice, and secondly, it suggests some key policy and managerial implications of the study based on a network perspective of the business landscape.



***Keywords:*** Innovation, construction industry, policy, views, network perspective

## INTRODUCTION

In this paper we focus on innovation in the construction industry in Sweden and Norway, where in both cases there is a tendency towards the state holding the industry responsible for not being productive enough while at the same time public funds for renewal efforts and research projects have been reduced (SoU, 2002:115; Ørstavik et.al, 2003; Bröchner, 2006). This indicates a liability shift in terms of which actors or which forces that are seen as the main triggers of technological and economic development; the state by its active involvement or the industry through the influence of "market forces". In the beginning of the 1990s a series of political reforms within housing politics were carried out in Sweden which basically shifted the responsibility of industrial renewal and residential property building from state to market, or to the industry (Lind & Lundström, 2007). The new reforms in combination with a continuous reduction of government funds to the construction sector have thus placed the main responsibility of industrial renewal upon the industry itself, and not the state. In addition this is a position which has become all the more strengthened through subsequent EU regulations. (See e.g. Lind & Lundström, 2011) The Norwegian case presents a similar tendency. Even if public funding in general is stronger in Norway than in many other countries, the government funds to the domestic construction sector has been reduced, at least in a relative sense, during the last decades.

This shift of responsibility from state to market and a policy recipe of increased competition being the key to increased innovativeness rest largely on an understanding of innovation as the result of one-party achievements on the "market"; single companies which develop new products and push it out to potential users, and customers that demand certain products which are then single handedly produced by manufacturers. In such a portrait of the business landscape competition undoubtedly works as the main driving force for innovativeness. From a network perspective, on the other hand, companies do not operate as independent units but are, through their interdependencies, embedded in a network-like structure (Håkansson et al., 2009). In this business landscape any new solution needs to fit into a network of established solutions, which makes innovation an interactive phenomenon involving several different actors and resources. Thus, the innovation process is not mainly spurred by competition but by interaction between actors and resources, between producers and users.

Previous research, such as in the UK (Fairclough, 2002), Sweden (Bröchner & Grandinsson, 1992; Bröchner, 2006) and Norway (Ørstavik et.al. 2003, Espelien & Reve, 2007) alike show that the construction industry is lagging behind when it comes to investments in research and development (R&D), which is further considered a prerequisite for innovation. Furthermore, the industry is characterized by adversarial relationships and weak ties between the different actors, particularly in the long run. This provides poor conditions for innovation according to a network perspective of product development and innovation.

By taking its primary standpoint in empirical findings about the construction industry, this paper investigates policy and industry views of construction innovation, and the apparent gap between these views and recent theoretical conceptions of innovation based on a network perspective. The study draws on the following methods: (1) A review of documents on government policies and practices in regard to construction R&D funding, (2) questionnaires to the construction industry in both Sweden and in Norway, and (3) CEO interviews in both countries (10 in Norway and 10 in Sweden), where the focus has been to reveal how innovation is viewed by the industry itself and how it actually takes place.

In the following sections, the paper presents a network perspective on innovation and then uses this theoretical basis to discuss and compare the findings from the review of documents

and reports on government investments in construction R&D and innovation as well as findings from the study of construction practice. The final section suggests some key policy and managerial implications of the study.

## A NETWORK PERSPECTIVE ON INNOVATION

### Innovation: two different phenomena in the model world and in the empirical world

For the last decade or so, innovation has been a buzz word in both the theoretical and empirical world; much management literature is pointing to different strategies of how to manage the innovation process in the pursuit of commercial success, and companies as well as industries are using it to demonstrate their progression and forward thinking. The view on innovation as a spurring force of technological development and economic growth has also made public policy a frequent user of the concept, pointing mainly to the potential advantages of engaging in innovation for actors such as companies and universities (See e.g. Eklund, 2007; Widmalm, 2008). From this perspective, there are three factors of particular value in fostering successful innovation: *novelty* of the new solution, *financing* of the commercialization process and, if the new solution is developed outside a commercial setting, *transfer support*. (Ingemansson, 2010) Another factor commonly pointed to is *competition*, implying that heightened competition between companies automatically results in greater innovativeness. This type of reasoning is more in line with the attainment of *invention* rather than *innovation*. An invention represents novelty of some sort, it needs to be financed in order to move from just an idea to something more concrete, and for this reason it also needs to become commercially produced somewhere. However, in order to become an innovation, i.e. a widely used solution, the new solution does not only need to be transferred from one context to another, it actually needs to *fit in* within these different contexts. When applied in a policy context such a view results in misguided recipes of how to promote innovation. First, if focus is directed on the achievement of novelty itself (invention) and not on its actual use (innovation), financing and transfer support are put before a deeper understanding of the using environment. Second, it suggests competition rather than interaction as a promoter of innovation. These are recipes anchored in an economic thought structure in turn based on models of the business landscape as "a market" in which innovation is instigated by either suppliers or users with price and demand as the only driving forces of renewal. (Dosi, 1982; Mowery & Rosenberg, 1979; von Hippel, 1976) From this perspective, innovation is not a reciprocal development process between producers and users but rather a linear procedure of new solutions being "pushed out" by technology providers or "pulled out" by potential users. In spite of its simplified view of the organization of business life this neoclassical market model still prevails much economic thinking, or as put by Snehota (2004, p. 16):

*"The neoclassical conception of market as the price determination mechanism is attractive. It has support of much of the theorizing in economics, is parsimonious and coherent and has gained a special status as the dominant perspective. The problem is that the neoclassical perspective on the market often provides only limited guidance for how to act within a market."*

However, empirically based research provides strong support for new solutions needing to fit within both a using and a producing environment in order to become an innovation. Firstly, it is indicated that a large number of product development projects fail because the resulting product does not sell as well as anticipated. This means that the potential customers have been unable to make use of the new product. (See e.g. Cooper, 1979; Dougherty, 1992; Pavitt, 1991) Secondly, when successful innovation does occur, which means that the new

product eventually becomes a widely used solution, it often takes place in established producer-user relationships. (Harrison & Waluszewski, 2008; Håkansson et al., 2009) This suggests that the mutual knowledge of each other's requisites and earlier investments, which accompanies long-term relationships, creates a high degree of relatedness between producers and users. This in turn increases the opportunity of producing something new which is actually useful and thus facilitates innovation. When this mutual knowledge does not exist, and a new solution is developed and produced *outside* such established relationship structures, the achievement of innovation becomes more difficult.

According to Van de Ven (1986, p.604), realizing innovation means the new solution has become an "*implemented reality*" and "*incorporated into the taken-for-granted assumptions and thought structure of organizational practice*". The new solution, whether material or immaterial, thus needs to become embedded in the established organisational and technical structures within its implementing contexts. For this to take place, the different settings involved in *developing*, *producing* and *using* the new solution all have to be able to create benefits from engaging in the innovation process. (Håkansson & Waluszewski, eds., 2007) It is not enough that a single manufacturer sees potential benefits of producing a certain solution if the prospective users cannot implement it. Or that a user sees great benefits of developing a new type of solution if the investments required to actually manufacture it within a producing setting exceed any future prospect of return on investment. Rather, the developing setting must see some kind of benefit of starting to develop the new solution, the using setting needs to embed the resulting product in its existing activities, and the producing setting must be able to support its production based on that use. (Ibid.) This implies that in order to become an innovation, any new solution must be combined and fit with the established structures within very different types of settings, and thus different economic rationalities, encompassing its development, production and use. It is further implied that this requires relatedness between producers and users. (Ibid.; Ingemansson, 2010) In the next section we will take a closer look at what it means to create new solutions in an interdependent business landscape characterised by different rationalities.

## The effect of the network

Today, a great number of the activities needed to complete a single product or service are carried out across the organizational borders of the single company, encompassing suppliers, supplier's suppliers, customers and so on. (See e.g. Gudeman, 2001; Håkansson & Waluszewski, 2002; Håkansson et al., 2009) This interdependency creates the need for companies to interact in order to facilitate daily operations and long-term effectiveness. From an interactive perspective, companies are thus embedded in a network-like structure in which they interact in order to ease the constraint of their interdependency. (Håkansson et al., 2009) This interaction entails a process of adjustment in which companies -producers and users- make investments with the purpose of creating a better fit between them. In this process particular solutions, or combinations of resources, are chiselled out in relation to each other through repeated investment. Eventually this result in a network of interdependent solutions connected to a continual pattern of investments, making these solutions difficult to replace or to combine with any solution that has been developed outside this network. (Gadde & Håkansson, 2001) Implementing a particular type of solution or technology which is not in accordance with the network will not only affect the solution or technology it replaces but the entire pattern of surrounding solutions, which makes it a very difficult and costly task. (Dosi, 1982; Rosenberg, 1994; Håkansson & Waluszewski, 2002)

Furthermore, the new solution will in some regard always bear marks from the network in which it was developed. As any solution rarely is completely new in the sense that all its

elements are "new to the world", it is always connected to the past; to established knowledge, conceptions or technical systems in its developing setting. (Lundgren, 1991; Van de Ven et al., 1999; Håkansson & Waluszewski, eds., 2007) Also, as we have realized, to become an innovation or an "implemented reality", the solution has to be applicable to the present and the contexts where it currently exists, which means that it needs to be adjusted to fit the surrounding conditions. (Ibid.) In turn, these contexts have a heritage of their own consisting of specific knowledge and systems of material and immaterial solutions from which the current state has emerged. This suggests that innovation is a historical product, bearing the marks from its developing setting in terms of which actors, resources and activities that was present in that network, which in order to become successful has to be adjusted to an implementing network with a history of its own. (Ibid.) As stated earlier, in the model world innovation is primarily seen as a spurring force of economic growth, and as such an inherently positive economic phenomenon, but as we can see, in the empirical world any change to the current pattern of investments equals costs as well as uncertain returns. We can also see that it is a matter of creating benefits for very different settings driven by different rationalities (in terms of their history and present situation); a developing network as well as an implementing one, including both a producing and a using setting. This means that in an interdependent business landscape involving different rationalities renewal is difficult as well as costly.

So far the discussion has mainly focused on the importance of viewing the single company as only a component in a larger network involved in the achievement of innovation. However, even if the single company is just a component, just as in any other system of components, in an industrial network each company must function in order to contribute to or benefit from the system as a whole. From an inter-organizational perspective, this means that in order for producers or users to benefit from the introduction of new solutions, these actors need to have the ability to actually create such benefits, by using both internal and external resources. (Håkansson et al., 1993) According to the "absorptive capacity" view proposed by Cohen and Levinthal (1989), this is highly connected to a firm's investments in R&D. From this perspective there are two sides of R&D; it can generate new internal knowledge leading to the development of new solutions, but it can also enhance the firm's ability to assimilate knowledge in the surrounding environment which then can be put to commercial use. From an interactive perspective there are however no clear boundaries between the activities and resources of the single firm and those made available through long-term relationships with other actors (Håkansson et al., 1993). This means that any firm need not only be able to assimilate new knowledge, through relationships or from "outside", but also to combine it with established knowledge and solutions which exist in the surrounding network. Thus, in order to have a positive effect on innovation, i.e. the achievement of a widely used solution, a firm's investments in R&D need to be combined with an understanding of how knowledge is transferred throughout the network to suppliers and customers and how it is put into use.

## Innovation in construction

In the construction literature, a great deal of attention has been paid to innovation. Common for these descriptions is that they take as their starting point the apparent lack of innovation and productivity in the construction industry, which in turn negatively affects the industry's performance (Egan, 1998; Koskela & Vrijhoef, 2001). A general observation in several countries is that the construction industry scores low on R&D expenditures and few construction firms take advantage of current R&D or innovation programs offered by governments (Seaden & Manseau, 2001; Miozzo & Dewick, 2004). R&D expenditures range between 0.01–0.4% of construction value-added for OECD countries (statistically limited to

contractors and sub-trades) compared to 3–4% in manufacturing or 2–3% for all industries (Seaden & Manseau, 2001). Several explanations are offered for why the construction industry is weak on innovation. Key issues are that construction is a low margin industry with many small companies, which lack the resources to invest in R&D and subsequently innovation. In addition, there is improper reporting of R&D expenses, clients are conservative and the government's policies are unsuitable for facilitating innovation in this particular setting.

The literature recognizes that the traditional conceptualization of innovation, measured R&D expenditures and the number of patents and/or new products is not necessarily applicable to describe innovation in this particular setting, or any other for that matter. Seaden and Manseau (2001) argue that innovation in organizational processes should also be considered. Organizational processes are very important in construction, as assembly methods as well as contracting arrangements are the core activities in this industry. The acknowledgement that innovation is both product and process related is reflected in the many definitions of innovation in construction. For example Slaughter (2000), defines innovation as "a non-trivial improvement in a product, process, or system that is actually used and which is novel to the company developing it" (Slaughter, 2000, p. 1466).

Blayse and Manley (2004) identify six factors driving or hindering innovation in construction. Firstly, clients and manufacturers are important drivers of innovation. The key role of the clients in promoting innovation is emphasized in the literature (see e.g. Winch, 1998; Hartmann et al., 2008), as their demands for a higher standard of work is likely to trigger innovative behavior among their suppliers. The manufacturing firms are also key sources to innovation. They provide innovative components, which is enabled by the fact that they operate in a more stable market, which in turn means that they can maintain R&D programs, learn from experiences and from that, build knowledge bases. The second factor is the structure of production, which in construction is temporary and characterized by one-off projects. Using innovative solutions across projects is limited, reducing the benefits of innovations and the incentives to innovate. The third factor is the relationships between individuals and firms within the industry and between the industry and external parties. The industry relationships are "loose", meaning that there are few benefits obtained from interaction and integration among the construction parties. This is in line with Dubois and Gadde (2002), who found that because of the loose couplings in the permanent construction network, great opportunities for productivity and innovation are missed. Blayse and Manley (2004) also mention the benefits from building relationships with "innovation brokers", such as professional institutions, universities and construction research bodies, who can act as repositories of knowledge and actively disseminate knowledge. The fourth factor is the procurement systems in construction. Instead of conservative procurement methods, such as lump-sum contracts that hinder innovation, methods facilitating team integration, such as partnering are likely to enhance innovative behavior. The fifth factor affecting innovation in construction is regulations/standards. While prescriptive regulations are seen to hamper innovation, many recognize that performance-based regulations can in fact facilitate innovation. This requires, however, that the regulators and policy makers possess sector-specific knowledge. In other words, the design of regulations and standards must be approached strategically. Finally, the last factor is the nature and quality of organizational resources, relating to the internal attitudes and processes conducive to innovation. Such resources include a culture of innovation, absorptive capacity, innovation champions, knowledge codification systems and an innovation strategy. These factors are important both

to policy makers and industry participants in developing innovation strategies that are applicable on the construction industry.

## RESEARCH DESIGN AND METHODS

The paper is based on a cross-sectional study of innovation in the Swedish and Norwegian construction industry, conducted between June 2010 and February 2011. A combination of quantitative and qualitative methods has been applied. Using mixed methods research allows for triangulation and to study different aspects of a phenomenon (Bryman & Bell, 2007). Such a complementary design was suitable for the problem at hand. In our study we wanted to identify different views of governmental bodies and practitioners in the construction industry related to innovation in the construction industry, and to discuss reasons for these differences and the implications for construction innovation practice. We studied the phenomenon in Norway and Sweden, since the construction industry in both countries faces similar challenges. The aim was not to do a comparative analysis as such, but to reveal interesting similarities and differences in the two countries to better understand the complex nature of innovation in construction.

In 2009, the Norwegian construction industry, including real estate companies (both service and finance), contractors, consultants, architects, rental companies, producers and trade companies, which delivers to the construction industry had a total turnover of 590 BNOK and employed approximately 250 000 people. The industry is characterized by some large contractors (e.g. Veidekke, Skanska, NCC, AF Group, etc.), but 97 percent of the construction companies in Norway have 20 employees or less. This high percentage is also true for Sweden. In total, there are about 500 000 people working in the Swedish construction industry, which include organizations involved in administration, architecture, technical consultation, construction, installation and manufacturing of materials. This represents 10 percent of the employment rate in Sweden. As three of the largest contractors, PEAB, NCC and Skanska, represent more than half of the industry's total turnover (which in 2008 was approximately 250 BSEK), similarly to Norway the industry is thus characterized by a few big actors and a large number of small and midsized companies.

The quantitative study consisted of two surveys in Norway and Sweden respectively. In Norway, the study of the construction industry was part of a larger research project on knowledge and innovation in the Norwegian industry. A standard questionnaire was developed for 13 different industries to cover topics relevant to innovation. The questions included type of firm (independent, part of national or international corporation, etc) the size of the firm (turnover, workforce, etc) and investments in competence development and R&D. Furthermore the questionnaire contained questions about characteristics of the firm's customer and supplier bases, as well as interaction with other actors including public authorities, competitors, alliance partners, customers and suppliers, and R&D organizations. In Sweden, the questionnaire specifically focused on the construction industry with questions concerning the key barriers and driving forces of innovation. More specifically this included aspects of educational level, routines for knowledge generation and knowledge transfer, organizational and technical progress during the last five year period, key relationships within the construction network and identified barriers for industrial renewal. The primary aim of the surveys was to collect data relevant for the assessment of the degree of interaction or dynamics between actors in the construction industries in Sweden and Norway that we perceived difficult to access through secondary sources.

In Norway, the questionnaire was sent to 4500 e-mail addresses covering the whole construction industry. The addresses were collected from the various industry organizations. 840 answers were received, approximately an 18 percent response rate. In Sweden, the questionnaire was sent out to all registered member companies of the national trade association with 5 employees or more, covering 2160 companies (almost exclusively contractors). This number also included around 200 group units for three of the largest corporations (PEAB, NCC and Skanska) spread over the country. 440 answers were received which gave a response rate of 20 percent. 75 percent of the answers were represented by independent companies while the remaining 25 percent represented group units belonging to the large corporations. This provided us with the opportunity to compare the situations of being an independent company and being a group unit within a larger corporation regarding efforts connected to innovation.

In conjunction with the surveys, the qualitative studies were conducted to receive up-to-date and in-depth data about the current business challenges and current views on and practices of innovation and interaction in the construction industry. Qualitative methods are useful to gain rich descriptions of interesting issues (Bryman & Bell, 2007), which in our study were barriers and drivers of innovation inter-firm interactions, competition, and actors such as firms, governmental agencies, and knowledge providers. For this purpose we utilized two data gathering methods: in both Norway and Sweden 10 semi-structured interviews lasting about 2 hours were conducted which yielded direct quotations from top managers in various parts of the industry. The questions concerned their experiences, opinions, feelings and knowledge (Patton, 2002) about technical and organizational development within their companies and the industry as a whole. In Norway, seven short case studies were also conducted, which provided an in-depth and contemporary understanding of the innovation phenomenon (Yin, 2009).

Both the quantitative and qualitative data were analyzed in a qualitative way, based on the theoretical insights focusing on drivers and barriers to innovation and the role of interaction between actors. We applied a concurrent triangulation approach (Creswell, 2009), which means that two or more data sources are compared to identify similarities and differences between the sources. This means that even if the response rates of the surveys were low in both countries, the purpose was not to generalize statistically from these. Instead several sources were combined to gain insight and increase our understanding of the perspectives on innovation of different practitioners (Bryman and Bell, 2007) in the construction industry.

In addition to the primary data sources, secondary data were gathered and analyzed. These included relevant policy documents and other reports of construction R&D and innovation. We searched for all available and relevant documents for our purposes, using archive data from both the Government in each country, Statistics Agencies, Public Funding Agencies and R&D institutes. While there are two recent formal investigations in Sweden and subsequent reports of R&D and innovation in construction, which we have found of immense relevance for our purposes, there have been few similar initiatives in Norway. Nevertheless, there are some reports of innovation in the Norwegian industry in general and also construction statistics, which we have used in the analysis. The analysis of the documents focused on identifying the views of construction innovation in these publications; definitions of innovation, and proposed problems and solutions, and public innovation practice, such as funding of construction-related R&D over the years. No formal interviews were conducted with policy makers. Nevertheless, the views represented in these documents and statistics over funding were interpreted as policy views and practices.

## FINDINGS FROM THE STUDY

### Construction innovation in public policies in Sweden

In the 1940s the Swedish government took a first step towards governmental funding for construction research by forming The Governmental Committee for Construction Research (SKB). Two decades later, a debate on whether construction research should be organized together with the existing scientific disciplines or be run within a particular research institute, resulted in the establishment of two organizations: one which would be in charge of distributing funds to universities and various institutes (The Swedish Construction Research Council) and one which would conduct research and development (The Swedish Institute for Building Research -SIB). This system remained intact for more than thirty years until SIB was terminated in 1994 (even though parts of the organization still exist at the University of Gävle). (Landin et al., 2011) This was part of a series of political reforms in the beginning of the 1990s drastically changing Swedish housing politics into what has been called "one of the most market liberally controlled housing markets of the western world." (Lind & Lundström, 2007, p. 129) Before these reforms the Swedish construction sector was subsidies in various ways making residential building primarily a state affair and not a market driven one. Furthermore, in 2000 the Swedish Construction Research Council, which had had the construction industry as its sole area of responsibility since 1960 was reorganized into Formas, which as a result became the new Swedish governmental authority handling research and development issues within the industry. Since then several research authorities and institutes which engage in questions regarding research and innovation within construction have been instigated, such as BIC (The Swedish Construction Industry's Research Center), the SP Technical Research Institute of Sweden, Boverket (The Governmental Authority for Community Planning, Construction and Housing), and SBUF (The Construction Industry's Organization for Research and Development) just to mention a few.

The great number of different research institutes, foundations and authorities connected to the construction industry might suggest that there is a strong and definite focus on construction research in the Swedish innovation system. However, when taking part of governmental investigations scrutinizing the role of these institutes and their total effort of supporting the industry another picture is outlined. From these investigations it can be concluded that construction is not treated as a strategic research area and that the research efforts are very fragmented and often diffusely divided into more broad areas such as "technology" and "society". (Bröchner, 2006; Prop, 2008:09:50; SFD, 2009:6) It is not a given that these broader themes are negative for the industry from a development standpoint (as it might offer some collaboration opportunities between different industries and research areas). However, not only does it make it difficult to assess how much research funding is actually put on construction or the direction and total scope of the different research efforts, but also how this research is used (or not used) by the industry.

Even the main governmental authority in command of research and development within the industry, Formas, has other responsibility areas, such as environmental issues and agriculture. In the hopes of getting a more concentrated and rigorous approach to the industry, since the restructuring of The Swedish Construction Research Council in 2000, merges and collaborations between different research institutes and authorities have been carried out. There have been several formal collaborations between Formas and BIC (The Swedish Construction Industry's Research Center), and in 2010 BIC merged with BQR (The Council for Constructing Excellence) to form *IQ Samhällsbyggnad* (The Swedish Center for Innovation and Quality in the Built Environment) (www.bic.se). Also, by order of the government in 2007, Formas started a formal collaboration with Vinnova, a Swedish

governmental body funding and facilitating innovation in various industries, regarding environmental technology where "sustainable construction" was part of the program. (VP 2007:02) However, besides this effort the overall focus on the construction industry is more or less obsolete within the research programs of Vinnova. (Bröchner, 2006; SFD, 2009:6)

In a debate article published in early 2011, the director of the SP Technical Research Institute suggested that the construction industry once again be appointed its very own research council so that the amount of funding to the industry would not be affected by other research areas considered of more strategic importance. (Ny Teknik, 2011) This tendency has also been addressed in an investigation made by SBUF. In a report on construction innovation it is concluded that the governmental effort in the early 2000s of appointing specific strategic research areas, also referred to as "strong research environments", has led to less funds being spent on construction research. Instead, due to the strict funding programs, the universities prioritize more fundamental research areas within the natural sciences, which are withheld as strategically important for Sweden's position as one of the leading nations within research and innovation. In turn this has made it difficult for both construction companies and academia to acquire funding for research efforts related to construction. (Bröchner, 2006; Landin et al., 2011)

Governmental investigations evaluating the quality and efficiency of the construction industry in Sweden can be traced several centuries back in time and even though there of course are many differences over the centuries as to what is in focus or passed judgment on in these investigations, some critique remains the same. In many regards the industry is constantly blamed for increasing housing prices and that it suffers from cartelization (and thus a low degree of competition), low quality as well as low efficiency. (Bröchner, 2011) In the beginning of the 21st century the Swedish government once again appointed a commission to investigate the construction sector's main barriers for industrial renewal. The commission was to examine and propose suitable measurements of how to "*promote the competition as well as counteract competition inhibiting behavior…and increase the quality within the construction sector*"[1] (SoU 2002:115, preface). In the resulting report the commission suggested that many of the industry's problems resided in the absence of competition which in turn was the cause of high prices, low productivity, bad quality and little encouragement for transformation. Another major concern was the role and position held by the developer, i.e. the clients. The commission suggested that the clients needed to become more knowledgeable and in a position of being able to put more demands on the final product. This in turn was put forth as being partly related to the law of public procurement and the legal dimension of which party that is responsible for any construction errors or negligence once the product is finished. In regard to research and development little was said about the companies' expenditure on R&D. The only conclusion that was drawn was that it is the larger firms that have the greatest ability and are sophisticated enough to provide new technology which can lead to "*important innovations*" (SoU 2002:115, p. 230), and that research, in addition to universities and various research institutes, is channelized mainly through manufacturers of material, components and equipment.

Seven years later, in 2009, the government decided to do a second investigation as there from a political perspective still did not seem to have been any real renewal or development of the industry. This time it was the Swedish Agency for Public Management which was in charge of investigating and reporting on the current situation in the industry. In spite of the rather

[1] Translated by the authors

nuanced picture which was outlined in the report of the industry and its familiar problems, one of the foremost advices and proposed solutions was still increased competition:

> "*Thus, a generally heightened propensity for change and more competition are according to The Swedish Agency for Public Management the single most important factors in increasing the spread of innovations and consequently the efficiency and quality of construction*."[2] (SFD 2009:6, p. 77)

Thus, the overall picture which emerges from the governmental support structure for research and innovation within the Swedish construction industry is that the large number of actors has created disunity and confusion as to *what* is being done and *how* the industry in turn makes use of it. It can also be concluded that the policy image which emerges from the two investigations made on the main barriers of industrial renewal, and which seem to have a long historical tradition in earlier investigations, is that the construction industry mainly suffers from a low degree of competition and that innovation would be positively influenced if competition increased in several stages of the supply chain.

**Construction innovation in public policies in Norway**

In contrast to Sweden, there have been no governmental investigations of industrial renewal in the Norwegian construction industry. However, there is a general concern over the Norwegian industry's low score on standard indicators of innovation and R&D. In 2008, The Ministry of Trade and Industry presented Norway's first white paper on innovation, Report No. 7 (2008-2009) to the Storting - An Innovative and Sustainable Norway. Innovation is here defined as "to do something new in order to create value". It is strongly emphasized that a new idea or invention cannot become an innovation before it is being applied and commercialized. It is also emphasized that moderate market competition provides a pressure on existing companies to improve and innovate. Strong or too weak competition, on the other hand, will instead hamper innovation. Furthermore, the importance of collaboration is acknowledged, as innovation is often the result from interaction between suppliers and users.

Construction-related issues are mentioned in the report, even if the industry itself is not explicitly emphasized. For example, the report refers to construction cases such as the use of innovative materials and design in the new Opera house in Oslo and the application and value of building information models in construction projects, which allow for effective information sharing. Nevertheless, when the report considers different areas that are important for innovation in general, such as the demographic development in Norway and the environmental challenges, it does not mention the obvious role of the construction industry in contributing to solve these challenges.

Even if there is apparently little attention paid to innovation in construction in Norwegian policy documents as such, the debate over this topic has, at least in some periods over the last years, been intense. The key sources to dispute seem to be the reduced funding to construction-related research over the last 15 years (as illustrated in Ørstavik et al., 2003) and, related to that, the lack of own research programs for construction in the Norwegian Research Council. Also the funding to the largest research institute, SINTEF Byggforsk (Building and Infrastructure), has decreased over the years, resulting in the institute being forced to move away from research to consulting. The Norwegian Research Council (NRC) is the chief allocating agency for research funding in Norway. In the period between 2005 and 2010, there was one public funded research program specifically dedicated to construction,

[2] Translated by the authors

initiated and funded by the Ministry of Local Government and Regional Development and the construction industry itself. The main objective was to reduce building costs. (Norwegian title of the program: Byggekostnadsprogrammet). The total budget was 185 MNOK of which the industry paid 105 MNOK and the Ministry 80 MNOK. When the program was finished, there was a discussion between the industry and the Ministry of how to continue the work. The industry suggested establishing a centre for R&D in construction, funded by the Ministry, but nothing has as yet happened and the discussion has faded away.

The industry organizations and the construction companies interpret this situation as a lack of interest in construction and understanding of its importance for Norwegian society by the Research Council, the different Ministries responsible for construction (Norway does not have any own Ministry for construction and building, but several Ministries share the responsibility) and ultimately the government. The reply, on the other hand, particularly from the research council is that the situation is a result of the lack of interest by the industry in applying to the council and also the fact that there are other, even if general, programs suitable for funding research on construction-related issues. There are in particular two such programs that the construction industry is encouraged to apply within. The first program is The SkatteFUNN tax deduction scheme. According to the Norwegian Research Council (2005, p. 2), the program is its "*most important instrument for promoting larger and more targeted R&D investments across a broad spectrum of Norwegian trade and industry. The scheme is linked primarily to the individual company's ongoing needs in development and innovation*". The main idea is that companies engaged in R&D activity on their own or in collaboration with others may apply for a tax deduction.

The second program is the User-driven Research based Innovation (Norwegian title: *Brukerstyrt innovasjonsarena,* abbreviated BIA). According to the work description by the research council (2005), this program focuses "*exclusively on research-based innovation, without being confined to particular thematic areas or branches of industry. Applicants will not be assessed on the basis of pre-determined thematic priorities, but will instead compete for funding on the basis of how well their proposed projects can contribute to research-based innovation and value creation*". According to the description, the program is open to projects that target different types of innovations. This includes: a) development of new or greatly improved *products*, in which the development or innovative application of new technology plays a central role, b) development of new or greatly improved *services*, which may include "service products" as well as services that support the various stages in the process of value creation (e.g. logistics) and c) development of new or greatly improved *processes*, in which increased productivity and improved quality play a central role. This may encompass production methods, organization forms, business models and delivery methods.

At the annual construction conference in 2010, *Byggedagene* (Norwegian title for the Construction Days), the CEO of the Norwegian research council gave a speech to the industry, where he addressed the apparent the lack of interest from the industry in applying within the different programs, particularly the BIA. The speech was titled: "Does the construction industry need research – and is it willing to?" He showed that the construction industry (confined to the executing part of the industry, that is, contractors and sub-contractors) has the least number of projects within BIA of all industries and that there has been a substantial decrease in construction-related applications and funding over the past years (from 31 million in 2007 to 24 million in 2010). He also illustrated that the industry does not apply when times are good, showing a correlation between increase in turnover and reduced number of applications. Compared to other industries, construction also participates

to a low degree in the Skattefunn program, and in an overall perspective uses very little of its turnover on R&D (less than 0.2 percent). He concluded that the construction industry simply does not use the public funding system and ended the presentation with outlining some barriers towards R&D in construction: the lack of sharing knowledge, lack of management competence, tendering – and contract strategies, too few demanding clients and little competition based on quality and customer orientation rather than price, and finally, the need for social sciences to understand construction.

## Views and practices of innovation in the construction industry

In the construction industry, innovation is seen as highly intertwined with project practice. Managers that were interviewed in the Norwegian study, describe innovation as a continuous development and improvement of existing work practices, solutions and products, which in the end result in something new that can be commercialized. As one of the Norwegian managers puts it:

> ”*I don't have any clear definition of innovation, but innovation occurs in projects. Ideas occur, which are further refined and managed. Innovation is not directed by any research program as such. Of course we take part in formal research programs to develop knowledge, but that it something else than innovation*”.

Similar to previous research, the Norwegian study reveals that the construction industry invests little in R&D compared to the general industry and it reports of fewer innovations. According to Statistics Norway (2009), other industries spend on average three percent of their turnover on R&D, while the survey reveals that 90 percent of the contractors and crafts businesses use less than one percent of their turnover on R&D. There are some differences between large and small firms, but still over 90 percent of the large companies in the general Norwegian construction industry (turnover above 100 MNOK) spend less than two percent of their turnover on R&D. The low investments in R&D can be seen in relation to the view of innovation as something that occurs through practice and not necessarily through formal R&D initiatives. Resources are spent on continuous improvements, which is reflected in the way the managers talk about innovation as ”the small steps”; ”stone by stone” and ”small, but frequent steps”.

Even if we find no great differences between small and large firms in the Norwegian study in regard to share of total turnover invested in R&D, we find significant differences when it comes to the extent to which the companies report that they have taken part in R&D projects. While approximately 90 percent of the companies with a total turnover below 100 MNOK say they had not run own R&D projects in 2009, 23 percent of those with a turnover above 100 MNOK and 44 percent of those above 500 MNOK say they had. Furthermore, when asked about whether they had participated in R&D collaborative projects in 2009, over 60 percent of the companies with a total turnover above 500 MNOK confirmed that this was the case. The Swedish questionnaire did not include questions regarding actual investment numbers, however, it is clear that investment in R&D is generally not perceived as the most important factor in increasing the innovativeness in the industry; only 19 percent of the respondents consider increased investments in R&D a decisive factor in renewing the industry. However, the same is true for 36 percent of the companies with a turnover of 140 MSEK or more, but only for 15 percent of the companies with a turnover of 81 to 120 MSEK. Also, there is a significant difference between the independent companies, generally smaller firms located outside growth markets, and the group units, generally bigger

companies located on growth markets: only 14 percent of the independent companies consider increased investments of R&D of highest importance for increased innovation, while this is true for more than 37 percent of the group units belonging to larger corporations.

In general, the construction industry reports to a higher extent than other industries that the innovations that do take place happen in collaboration with others (Statistics Norway, 2009). This correspond with the emphasis on projects as the main source to innovation, and in construction, projects are per definition inter-organizational. In the Norwegian survey, we asked about the importance of different actors for the company's development of new ideas, processes and products (i.e. innovation). Local customers are considered the most important, followed by suppliers and personal networks. An interesting finding is that even if suppliers in general are seen as important for innovation, when asked about the strength of relationships with specific industry actors, Norwegian contractors view their relationships with suppliers (e.g. technical contractors, trade organizations and producers of materials and products) as week. This indicates that even if suppliers are viewed as important for innovation, the companies do not have appropriate relationships to exploit the opportunities.

In the interviews, we asked the managers to elaborate on this issue. Both the Norwegian and the Swedish construction managers agree that there is too little collaboration in the industry. As one of the Norwegian managers points out:

> "*We have ways of relating to each other that hamper innovation and I don't think we work together in a very smart way*".

All of the Norwegian managers emphasize that closer collaboration in the supply chain is a key focus area. This was also an apparent issue brought up in the Swedish CEO interviews. The view was that if other industries can keep the supply chain together and provide an integrated offering to its clients and end consumers, then why cannot the construction industry do the same? This in turn would require close upstream interaction between consultants, different contractors, specialists and suppliers. To some degree this type of interaction exists and when asked to give examples of innovations in the companies, the managers in the Norwegian study describe innovation processes clearly characterized by close collaboration with other actors. Nevertheless, there are still obvious disruptions in the conjunctions between these actors where procurement issues get a lot of attention. The focus on price and arm's length relationships are seen as a main barrier to innovation in the construction industry. Construction is a low-margin industry and the managers report of a strong focus on price in all parts of the industry, which, in turn, gives few incentives to invest in R&D and innovation; customers primarily choose the lowest bid anyway. There is a concern that public clients do not invest in and contribute to supplier development in this industry, compared to for example the Norwegian gas and oil industry. As the CEO of one of the main contractors explains:

> "*When price means everything, it is impossible to think about innovation in a low-margin industry*".

Some clients, however, both in the private and public sector, have started to include other selection criteria but price when contracting, such as competence and suggested solutions. Together with the development towards larger and financially stronger companies in the industry, the Norwegian managers see this as an important condition for increasing their investments in R&D and innovation.

Just as in Norway, in the Swedish survey customers are considered a very important source for the development of new products, services and processes but also co-workers, which is considered an equally important source. This is in line with the general conditions for the industry; the "one-off nature" of the projects, which in a sense makes every product a prototype, makes the client a central actor in formulating specifications of requirement which often set the frame of the project (the clients role in the proceeding process however depends on which type of contract that has been settled). A high percentage also on co-workers as the most important source for innovation suggests that, besides customers, external sources of knowledge are only considered in an indirect fashion where co-workers are seen as links to other actors in the projects. However, even if the survey shows that suppliers are not considered the most important party in renewal efforts, it is clearly shown in the CEO interviews that suppliers are involved in such efforts through the provision of both new products and services. Thus, in both Norway and Sweden there seem to be an inconsistency between the *view* on suppliers and subcontractor in regard to innovation, and their *actual* involvement in renewal efforts.

Besides of customers and suppliers, both of the surveys also included questions about the importance of other external actors for innovation. The results show that R&D institutes and public funding agencies are in general considered least important. Yet, again, in the examples of innovations, several of the managers describe how R&D institutes contribute to the process and some managers even consider them as fundamental. A key concern is that the basic funding to such institutes have decreased, meaning that they have to rely on consultancy work instead. As such, their objectivity is questioned. Several of the Norwegian managers claim that the industry is ignored by public funding agencies, which may explain why these are considered of little importance. Some also explain that it is far too resource consuming to apply to the Norwegian Research Council (NRC). There is a general feeling that the Norwegian Government pays little attention to the industry beyond considering it a main tool for fighting recession and avoiding too high unemployment rates; the industry does not have its own Ministry, but must relate to many different ones, and it does not have own programs in the NRC. An acknowledged exception is the focus on reducing energy consumption and emissions in buildings and building materials (e.g. concrete), which is reflected in new regulations and NRC funding. In several of the Swedish CEO interviews another particular reason for why these actors score low is also put forth; the barrier lays in not wanting to share with others. If a company develops something internally or in collaboration with a client or a supplier, it more or less becomes a property of the company and can thus be used as a competitive advantage. If a new solution is developed in collaboration with a research institute however, such as SBUF, it becomes "public property" and available to every company. There is also the sensation that R&D institutes and the governmental support structure need to take on a more holistic approach to the industry and not just consider specific issues. In general, the focus on environmental issues is considered by the managers as a key driving force to innovation in today's construction industry. It is, however, a concern that the regulations will contribute to innovation initiatives only if accompanied by sufficient funding and focus on competence development.

## CONCLUDING DISCUSSION AND IMPLICATIONS

The relationship between public policy and the effects that it creates, in whatever industry it tries to affect, is highly complex and therefore very difficult to evaluate. There will not only be "direct" effects in the shape of measurable outputs, but also "indirect" effects created through interaction between different actors in turn both directly and indirectly related to the

particular policy influence. Due to the nature of these indirect effects of not appearing in the shape of clear-cut and measurable outputs, but rather as socio-economic echoes appearing at unexpected times and places, they are impossible to predict and also very hard to examine; their connection to past regulation might be far from obvious.

That there is a gap between public policy and the industry in regard to how renewal actually takes place in the construction sector is not very surprising, it is rather the nature of this gap and the consequences which it already has and also might result in, which are quite disturbing. What this investigation of Norwegian and Swedish public policy and practice in the construction industry has shown, is that the public efforts of supporting the industry are fragmented as well as declining. In addition, despite the vital role which the industry plays both in regard to employment rate and to building communities, a number of different governmental actors share the responsibility of the industry and have several other responsibility areas which seem to get more attention. This clearly indicates a liability shift in terms of the state taking less responsibility for the construction industry and its situation, and thus shuffling off the supposed productivity problems to the industry itself. In Sweden this has been part of a series of political reforms within housing politics restructuring the governmental support structure during the last two decades, which has also been an ongoing development in Norway. However, while this development has been going on, the public debate about the industry has focused on the lack of research efforts and how the industry needs revitalization. Thus, while there has been great talk of what needs to happen the funding enabling such action has drastically decreased.

What is the policy recipe for increased renewal and innovation then? While there seems to be a common picture of innovation as the actual use of new solutions, and that clients matter a great deal in this process, the main recipe of how to achieve innovation is still through increased competition. Particularly in the Swedish context, where this is explicitly advocated in two public investigations carried out in the last decade of the main barriers for industrial renewal in the construction industry. Norway presents a more nuanced picture where the policy view of the construction industry is that moderate competition is beneficial and that competition in regard to quality rather than price needs to increase. However, here policy makers seem frustrated that there is not a closer relationship between the government and the industry and blame the industry for not applying to available research programs. The Norwegian construction industry, on the other hand, has a different view of the matter and think there is little interest from the government in terms of relevant research programs and funding.

Both in Sweden and Norway the industry's view on equally internal and external research efforts is that they have little connection to renewal and innovation. It is instead collaboration with clients and the "small steps" forward in the different projects which are seen as key to the development of profitable and sustainable solutions. This is reflected in the industry's investments in R&D which are very modest compared to other industries. However, here there is a difference between smaller, independent companies and units within larger corporations. The latter seem to have a more positive attitude towards R&D and have made more investments in research and technological development during the last few years. In addition, suppliers are generally seen as less important for renewal than clients, and in the Swedish case even less important than co-workers, which suggests that there is relatively little upstream interaction in the construction network.

Earlier studies on innovation in the construction industry also show that a stressing issue is the loose couplings between the different actors in the construction network (see e.g. Dubois

& Gadde, 2002). From an interactive perspective, interaction and relatedness between producers and users are the foremost reasons for achievement of innovation, which suggests that the obvious lack of such interfaces hinders innovation within the construction network. When price means everything, as the managers in the study point out, relationships are hard to establish. This, in turn, reduces both opportunities and incentives to innovate. Perhaps the network structure of construction in fact hinders innovation; there are several interdependencies, but because of the inability to establish proper couplings, the continuous confrontation of different logics and rationalities act as barriers to innovation and drivers of loose and standardized interfaces. The strong focus on competition as the key to increased innovation indicates that the prevailing policy image, particularly in Sweden, is more influenced by an economic thought structure in which innovation is seen as achieved by single actors through a "push-and-pull" mechanism, where the only influencing factors are price and demand (See e.g. Dosi, 1982; Mowery & Rosenberg, 1979; von Hippel, 1976). Such a view clearly fails to see the interactive effects acting within the constructing network which, as stated above, can act as both hinders and drivers of innovation. Also, earlier studies also suggest that R&D spending is low compared to other industries but as stated by Seaden and Manseau (2001) this might not be a proper tool to measure industrial renewal within construction. The nature of the industry of being project based and organized in terms of different activities and processes might suggest that much development is organizational rather than technological.

What does this mean for regulators and policy makers, the industry, and how should we use theory to capture what is going on? The lack of an organized structure for construction-related research (and thus indirectly education) seems an obvious problem. As stated by Blayse and Manley (2004), building relationships with professional institutions, universities and research bodies can have a positive effect on innovation. It is however not a problem from the perspective of the industry not being able to make *direct* use of new knowledge being produced, by straightforwardly transforming it into new solutions, but from the perspective of the *indirect* benefits which such knowledge production provides. These are benefits in the shape of educated people entering the industry and of a strong knowledge base being produced over time, eventually and slowly leaking out to be applied in different industrial applications. This type of knowledge is already embedded in the methods, processes and equipment which the industry uses today. However, which type of research or knowledge they are based on is far from obvious which makes the downsizing of various research efforts and knowledge production related to construction a risky business. The effects are already apparent; the industry is in need of a stronger knowledge and research base. How it is to make use of it is however a different matter and a far from obvious one. Nevertheless, what has become clear in this investigation is that while public funding of research efforts are necessary through the indirect benefits which they provide over time, the industry itself also needs to shift focus in order to be able to make use of such knowledge. The awareness and use of external knowledge sources need to increase and a more open approach to research and development, both in regard to internal and collaborative efforts, appear to be required.

In regard to the loose couplings in the network, there seems to be awareness of this within the industry. In addition, there seems to be a view of suppliers and subcontractor as less important in renewal efforts than they actually are, at least in Sweden. This view might be the result of two interacting factors; how public procurement is implemented, in regard to price being the only focus, and the unstructured collaborations, in terms of new clients, suppliers and subcontractors being involved for each new project, which this presupposes. The question is if this can be adjusted through new regulations or if the problem lays in the very

implementation of the regulations, and thus in the structure of the construction network. Either way, if regulations and standards meant to facilitate renewal are to fit with the industry there needs to be an understanding among regulators and policy makers of what drives and hinders innovation in this particular setting. Otherwise, as suggested by Blayes and Manley (2004), they might represent obstacles instead of enablers of renewal opportunities.

Earlier studies of innovation in construction point to the need for a deeper understanding of the industry in terms of its organizational challenges, and how relationships are formed (on not formed) throughout the network. This suggests that an inter-organizational approach of innovation is a suitable method in trying to capture how different types of renewal take place in the construction network. In this study it was used to understand the relationship between policy and industry in terms of views and practices in regard to innovation, and also how the industry views its relationships with other actors in the construction network.

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