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Reconfiguring the construction business system

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Co-Production of Users, Producers and Products – Reconfiguring the Construction Business System

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Abstract

The purpose of this paper is to analyse how the construction business system is being reconfigured as a result of the mediation processes between product characteristics and user requirements, and how the mediation processes reshapes the boundaries between companies, products/concepts and users. The starting point of this study is the recognition that responses to a seemingly low level of construction innovation so far has had a tendency of addressing either technology-driven innovation or, in recent years, user-driven innovation. Instead, we wish to investigate the "field-in-between" production and consumption in greater details to emphasise the interactive nature of construction innovation. This study applies innovation theories, especially theories concerning users' role in the innovation process, along with theories of social-constructivism. The research design is based on a case study design involving interviews with main stakeholders and documentary analysis of five cases: Two in Denmark, one in Sweden and two in France. First, the results show that users do contribute to innovation in construction. They may act as active agents in themselves or as representations through e.g. spokespersons or market surveys. Second, the co-production of companies, concepts/products and users reshape the construction business system in important ways when it comes to the organisational structure within the company itself, between the companies, and between the companies and the users. In conclusion, if these rather temporary and fragile reconfigurations of the construction business system are to be sustained, it requires strategic decisions.

Keywords: construction business system, innovation, industrialisation, client, user

1. Introduction

Users have been introduced as a new source for companies' innovation. This has primarily its roots in the understanding of the market as an incentive factor for technology development and changing processes in the society. In the strategy of user-driven innovation, there is focus on the need for development of competence among the actors in the construction sector in order to capture the inspiration etc from users. It is the hypothesis of this paper that to realise user-driven innovation, you have to understand the production and consumption symmetrically. This implies an understanding of who the users are, how the interaction is between use and production, and what effects the intensified interaction with the users can have on the production system. Or in other words the companies have to go beyond the mechanisms of the market to see who the users are and how they can meet them. This shift from production towards consumption of the built environment (and its associated products and facilities) is likely to manifest itself in various forms. These manifestations will be explored in this paper.

The paper used two perspectives to understand the users. The first perspective relates to the consideration of lead users and the second perspective relates to the understanding of users as socially constructed. Von Hippel's lead-user concept played a significant role in the design of existing programmes in Denmark, including the Danish Enterprise and Construction Authority Programme for User-Driven Innovation. With the concept of lead user, focus was put on the role that users can play as drivers of the innovation process. In the paper we wanted to focus on all the different meanings that users may have in an innovation process, and hence there has been a need to broaden the understanding of users, with contributions from a social-constructivist perspective.

User-driven innovation refers to innovation processes, where the recognised and unrecognised needs of users form the basis for the innovation process. The idea was that producers must understand not only the articulated needs of users, but their silent needs, and focus on developing solutions to meet customer needs. There are various factors that should be considered in a discussion of who the users are.

In connection with acknowledged needs of users, it is feasible to identify specific users with specific characteristics / features, where these users would be carriers of the needs. In this context it would be relevant first to identify the user groups and then to assess whether their needs would have a broader support among a wider audience of users, either by the growth of the user group, or by other user groups having the same needs. In this context the analysis benefitted from the lead user approach.

In connection with unacknowledged needs, the needs are embedded in values, cultures, technological opportunities as potential needs. At this stage there is not necessarily user groups in existence. The articulation of unacknowledged needs and the constitution of user groups are parallel processes and the development will take place through interaction between various actors who interpret and negotiate the "needs" rather than identifying their needs. In this context one cannot necessarily point to an existing user, but should rather focus on the forming process of "needs" and "user groups". In this context the analysis should rather draw on the social construction approach to catch the understanding of the shaping of the users.

2. Research design

This paper sums up the results of the work undertaken in the international collaborative project 'TRANSUSERS – transforming the construction sector through user-driven innovation'. TRANSUSERS was carried out in 2007-2009. The project was executed in collaboration between CSTB (France) and SBI/AAU (Denmark). The objectives of the project were:

- To analyse how users are shaping and are being shaped by a reconfiguration of industrialised design and production methods in the construction industry.
- To analyse how the construction business systems is being reshaped due to the interplay between production and consumption in the built environment.
- To develop strategic recommendations for decision-makers in firms on reconceptualising industrialisation and applying user-driven innovation.

This research is based on five case studies. Case studies are relevant in situations where there is a need for exploring phenomena as they appear in reality. The case study is a research method where we go in depth with a single or few cases, and draw out the specifics, which can have a more general character and interest. By choosing the case method, the choice of case becomes an important methodological question. Flyvbjerg (1991) defines different strategies to select cases:

- The paradigmatic case is chosen when the wish is to have cases work as a metaphor or establish a new way of dealing with issues relevant to this study.
- Extreme and deviant cases are cases where you look for extreme or deviant characteristics for example the specifically problematic or the specifically successful.
- A critical case concerns a superior aspect and makes it possible to generalise within this superior aspect.
- Maximal variation cases are cases where we involve various different cases to examine the problem and where the cases are different concerning one or more dimensions.

These methodological strategies cannot be considered as separate strategies, but can be used to specify limits and possible generalised conclusions on the cases included. The last strategy of maximum variation cases is the most relevant methodological strategy to this particular study overall. But each of the case studies may inhibit characteristics that make each of them paradigmatic. The cases have been selected to reflect differences in:

- Construction business systems: France as an example of an industry-driven system versus Denmark as a profession-driven system.

- Business models: Production-oriented business models versus project-oriented business models.
- Product scales: Complete buildings versus system components.
- Different representations of users: Directly and indirectly.
- Types of innovation: Product, process, marketing and organisational innovations.

It is characteristic of case studies that they make use of many diverse sources of information: interviews with key persons, documentary material, site observations etc. Consequently, the project team developed a common guideline to ensure the collection of data on a number of selected common issues to make comparisons and cross-cutting analysis possible. The different themes of the analysis are: 1) Context - business system? 2) Who are the users in the case? 3) What are the roles of the users? 4) Characteristics of the innovation process? 5) Effects on the construction business system? 6) Implications?

3. Theoretical perspectives

3.1 Framing consumption of the built environment

The analysis will draw on a combination of innovation theories dealing with the role of users most notably the concept of lead users and various constructivist approaches on the co-construction of users and technologies.

3.1.1 Innovation management: lead users

Within the demand-pull model, von Hippel (1986) has been highly influential in showing the importance of users in the development of new technologies. Von Hippel (1986: 791) in particular has introduced the concept of lead users:

Lead users are users whose present strong needs will become general in a marketplace months or years in the future. Since lead users are familiar with conditions which lie in the future for most others, they can serve as a need-forecasting laboratory for marketing research. Moreover, since lead users often attempt to fill the need they experience, they can provide new product concept and design data as well.

Franke & Shah (2003) has studied how user-innovators outside firms obtain innovation-related resources and assistance to develop their ideas and how they share and diffuse the resulting innovations. Based on studies of individuals belonging to voluntary special-interest communities like windsurfers, Franke & Shah (2003: 157) states that:

We find that these individuals often prototype novel sports-related products and that they receive assistance in developing their innovations from fellow community members. We find that innovation-related information and assistance, as well as the innovations themselves, are freely shared within these communities.

In a similar vein, Jeppesen & Molin (2004) has studied how the development of online computer games relies on an external consumer community for innovation. Jeppesen & Molin (2004) suggest that learning and innovation efforts from which a firm may benefit need not necessarily be located within the organisation, but may well reside in the consumer environment. Based on an explorative case study, Jeppesen & Molin (2004: 363) shows:

'...that consumer innovation can be structured, motivated, and partly organised by a commercial firm that organises the infrastructure for consumers' interactive learning in a public online domain.'

The theoretical contribution of innovation management, in particular the concept of lead users, is the emphasis on change and the role certain groups of users may play.

3.1.2 Agency and structure: mutual shaping of users and technologies

Since the 1980s it has been argued within science and technology studies (STS) that technology is socially shaped and designed. The point of departure in STS is that technical objects and social relations are bound together and that actors and technology are co-constructed. The distinction between the social and the technical is not given beforehand, but is the result of a mutual shaping process (Bijker et al. 1987; Bijker & Law eds. 1992). Pinch & Bijker (1984) were some of the first to include the users in technology development by introducing the concepts of interpretative flexibility and relevant social groups in their SCOT approach. In the now classical study of the birth of the bicycle, Pinch & Bijker (1984) illustrate how other perspectives and groups than engineers, designers and scientists enter into the design process by defining problems and develop solutions interpreted through respective technological frames of the groups. The technological frame guides thinking and interaction within and between the different relevant social groups.

Based on a collection of papers from various theoretical starting points, Oudshoorn & Pinch (eds. 2003) attempt to bridge various approaches to the co-construction of users and technology. The approaches on the studies can be grouped in four: 1) The SCOT approach focusing on users as agents of technological change, 2) feminist approaches focusing on diversity and power, 3) semiotic approaches to users focusing on configuration and script, and 4) cultural and media studies focusing on consumption and domestication. In their summary of the approaches and studies, Oudshoorn & Pinch (eds. 2003) identifies three main conclusions. First, the collection of papers addresses the active role of users as well as resistance and non-use in shaping socio-technical change. Second, focus is on the multiple collectives like advocacy groups and experts who attempt to speak on behalf of the users and the ways in which they represent the diversity of users. Third, focus is turned towards the multiple locations where the configuring of users in the development of technology is taking place. These locations include the design phase of a new technology, testing by clinical trials of drugs and the mediation process between production and consumption, in which mutual articulation and

alignment of product characteristics and user requirements is taking place. In sum, although the collection of papers show the creative agency of users in shaping socio-technical change, the studies also show how agency is constrained by government regulations, gender relations etc.

An explicit focus on users and the context of use or consumption add significantly to our understanding of how the built environment is being constructed. In various ways, the different approaches struggle with the dualisms of actors/structures and objects/subjects. Although the approaches and studies may in various ways inform an analysis on the users' role in industrialisation in construction, it is also apparent that the bulk of studies do not explicitly address construction or the built environment.

3.2 Framing production of the built environment

Gann & Salter (2000) provide an analytical framework that can situate change agents of construction in a context of the regulatory and institutional framework on one hand and the technical support infrastructure on the other hand. First, every construction organisation is embedded in a context of not only markets but also politics and technical support infrastructure. Both shape the boundaries of possible action of the firm in important ways. Second, construction in general operates in a context of project-based services. As noted by Gann & Salter (2000), a major impediment for innovation in project-based service firms is the gap between the project-based processes and the business processes of the firm. The project-based nature of construction implies that the interdependencies are primarily linked to the rather fluid, changing and ad-hoc patterns of cooperation with a rather large number of external firms.

The strength of this analytical framework by Gann & Salter (2000) is its strong emphasis on putting construction into context – a context of both knowledge and policy-making. Another attraction of the framework is its recognition of not only actors but also activities taking place. Further, the framework acknowledges not only the construction industry in a traditional sense – namely contractors and consultants – but it also includes the manufacturing industry delivering most of its output to the construction industry. The weaknesses of this approach are twofold. First, couplings between the individual elements are primarily framed in terms of knowledge flows. Thus, issues of power as well as the mechanisms through which the interaction takes place are less well-developed. Second, the framework squeezes together clients, owners and users into one group. Concerning the construction business system the analytical focus in this paper is mostly on the supply chain, project-based firms and projects.

Innovation is generally considered to be the key driver of improved wealth and welfare. Several definitions of innovation, technological change, technical development etc. can be found in the literature. One authorised definition is provided by OECD in its Oslo Manual (OECD & Eurostat 2005). The third edition of the Oslo Manual on collecting and interpreting innovation data defines innovation as (OECD & Eurostat 2005: 46):

*'An **innovation** is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.'* (original emphasis)

3.3 Framing the relation between consumption and production

There is an interaction between consumption and the construction sector. Constitution of users depends on the existing traditions in the construction sector and the readiness of business to change. Existing traditions include strategic orientation of companies, division of labour, communications and forms of collaboration within and between enterprises, and ways to interact with customers. Constitution of a user depends on the production system and the stability of the production system depends on the market and its users. Constitution of a user can be both supported and oppressed by the production system, as the constitution of a user depends on a responsive production system that can deliver products that meet the needs of users (Blismas 2007.) One can ask the more fundamental question of whether a user exists at all, if there isn't a production system and a product that meets user needs and vice versa. Constitution of a concept / product and a production system may otherwise be both supported and oppressed by the market, as the stabilisation of a concept / product and a production system depends on a receptive market that will buy the products. The hypothesis in the paper is that the interplay between consumption and the construction sector is as shown in Figure 1 below.

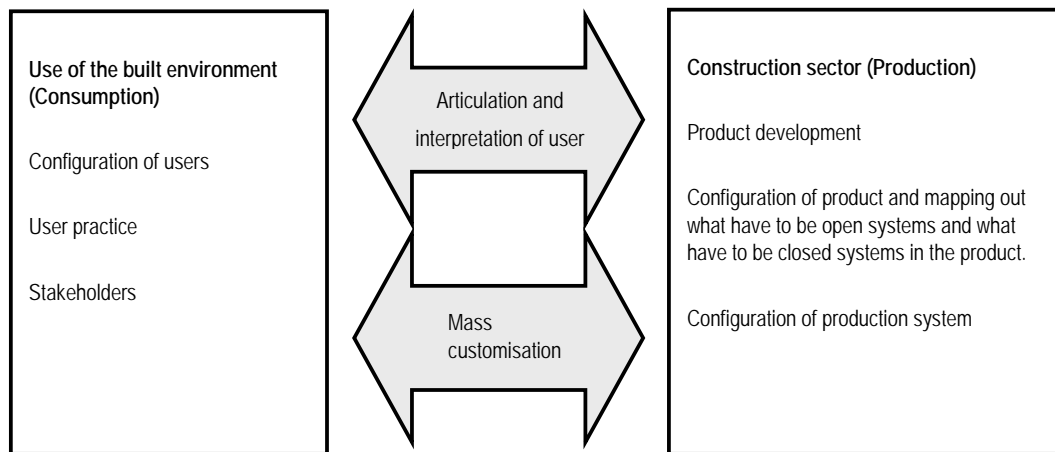


Figure 1: The interplay between consumption and the production of the built environment.

The upper arrow shows the interaction between the consumption and the production with relevance for the unfinished products. Schot & de la Bruheze (2003) focus on the mediation process between production and consumption and characterise this mediation process as a process of mutual articulation and alignment of product characteristics and user requirements. They involve not only the user but also spokespersons for the users in the articulation of user requirements. In the mediation process, the user demands can be expressed by real users, projected users and represented users. The box on the right shows the processes in the construction sector or the single company where

development and adaptation are central processes. The lower arrow shows the interaction between consumption and production with relevance for the finished product. This interaction will be characterised by being a market situation with a sales person and a purchaser/customer.

4. Five cases

4.1 BoKlok – housing concept based on market surveys

Skanska is a contractor and Ikea is an industrial manufacture of furniture with large sales shops. In the cases of BoKlok, a strategic partnership was set up, which jointly developed an industrialised home building concept for low budget housing based on market surveys of user preferences. Identifying different user representatives and conducting a market survey provided BoKlok with valuable information of what the important design criteria were. The users were not directly involved in the innovation process to any significant degree. Thus, the users played a predominant role as data sources, leaving aside the development activities for the development teams. Consequently, the approach could be characterised as an approach, where BoKlok shaped a new user "house owner with low income". The goal of BoKlok is to sell buildings to low-income groups. To do this, they developed a process similar to what one finds in the industry. The homes have been designed around factory processes that facilitated that they were far more efficiently constructed in quality-controlled conditions. The buildings were transported in 3D to the site where the same team mounted and finished the homes. They built up feedback systems to ensure continuing improvements concerning the processes and the product. They succeeded in building up an industrial production system in cooperation with actors in the construction sector. As a part of their business plan, they have to export the homes. They succeeded in adapting to cultural differences between end-users in different countries e.g. size of windows, bath instead of shower head. The concept was flexible and could be tailored to the differences in local requirements. In the Danish context the barrier for diffusing the homes was not the end-users, but local authorities who sells sites and gives building permits There are different explanations of why the local authorities did not always welcome a BoKlok project in their local area, but the lesson learned was that important market structures could be a major barrier for a successful implementation of an industrial concept. Strategies had to be developed to integrate not only the end-users in industrial concepts, but also stakeholders who shaped and maintained market structures.

4.2 HTH – web-based configurator of kitchens

HTH – the largest manufacturer of kitchen solutions in the Nordic region developed a web-based product configurator for end-users to individually configure kitchen solutions for their private homes. The goal of HTH was to compete with other kitchen producers about the DIY market. At that time HTH already had an industrialised production process, where the shops' orders through a configurator directly linked to the production in the factory. The new configurator gave rise to a discussion between HTH and the shops selling the kitchen, about user competences due to internal relationship

and division of labour between HTH and the sales people. They ended up constructing a user with competence to make only a raw design of the kitchen. The measurements of the dimensions in the kitchen, the final design and order of the kitchen are still made by the sales people. HTH did not change their existing work methods and relationship between the factory and the shops, but the introduction of the configurator put pressure on the company to change the structures. Depending on whether the company chose to change the structure or continue with the existing practice, the constitution of the "user with design competence" will either be strengthened or repressed. It is an open question whether HTH reorganises the relationship between the shops selling the kitchen and the production of the kitchen so that they get the industrial effect of the user-configurator. The strategic question for HTH is, whether they can handle two different target groups on the market, with different needs and solve internal aspects concerning positions of the different actors.

4.3 Rockwool – marketing concept based on dual roles

Rockwool is a manufacturer. Rockwool uses an employee in the role of lead user by following his private building project of his own low energy house. This gave Rockwool direct access to the users' preferences through the users' choice during the building-project concerning the building process and the product. Rockwool communicates the experiences of the building project on their homepage as a part of their marketing. Running evaluation of the marketing concept and the direct contact from users to the employee caused the company to identify a new user group "Do it yourself do it for me". They constituted the new user group as a group that demands information so that they could qualify themselves to control their own building projects, but still with professionals to do the practical work. The employee at Rockwool can be seen as an end-user. He built his own house mindful of using well-know methods and products to reduce uncertainty. In that sense he used industrial principles. He used prefabrication of different subsystems which he put together to a low energy house. Rockwool borrowed his network of suppliers of subsystems to inform about their products as a part of the communication of the building project, because Rockwool itself did not want to be a part of a strategic partnership. The market, especially DIY and a new market segment, a critical group "Do it yourself do it for me", were very interested in the relationship between the different subsystems, which together made a whole low energy house. In that sense the case showed that it is not only the physical interface between subsystems that are important to focus on in an industrial perspective but also relationship between products, suppliers (actors) and information. In spite of market needs, it is still an open question whether the materials producers want to form closer strategic partnerships together in order to meet the market needs. Depending on the strategic choice that Rockwool has to make, the constitution of the new user group will be either strengthened or repressed. Most likely Rockwool will not take this step, and there is a risk that the user group will disappear because of a missing production system. At the same time one of Rockwool's traditional target groups, the architects, plays an important role for Rockwool's choice. One of the characteristics of architects is that they want freedom to choose the various building components themselves. By linking different building components, Rockwool risk that their products will be perceived as having closer connection with some than with others.

4.4 Maisons MACCHI – system delivery based on failed expectations

Maisons MACCHI is a local French builder of individual low energy homes. Due to the growing attention paid to building's energy consumption in policy and regulation and a wish to better the working conditions on the building site, the company firstly introduced a new concept of prefabricated walls and secondly redesigned its production and business processes to accommodate user requirements and regulatory requirements by implementing a quality management system based on ISO 9001: 2000. The impact of the quality management system was positive. Planning activities upstream requires a consequent investment but it also saves time on the building site. The activities become more fluid and the productivity is higher. The quality of the end product, the low energy house, appears also to be much higher than with traditional approaches. At the building site, the teams are mobilised to correct defects. It proves that improving quality reduces expenses while increasing productivity. However the diffusion of the constructive system is limited, because MACCHI did not design, build and sell many houses. Competitors using traditional masonry remain less expensive and attract most households that do not look at the life cycle costs but focus on the level of their initial investment. The diffusion of the constructive system would require additional funds to ensure its development and marketing. Moreover a more stringent regulation concerning energy consumption would be necessary to spur the market for low energy houses.

4.5 ACCOR Hotels – client as driver of industrialised refurbishment

In the case of ACCOR Hotels, the client acts as driver of innovation on the renovation of the low budget hotel brand F1. The goal of ACCOR was to renovate the hotels while still offering customers the lowest price in the market. To optimise the productivity of the building site and to promote learning, the technical direction set up several initiatives: long-term contracts, a “Plug & Play” approach, a just-in-time approach and the presence of a back-up company. To minimise the costs of the renovation, the hotels of the chain “F1” were gathered in regional batches. Each of these batches was then entrusted to a project team. Ten contractors and five technical designers were provided with the batches which are controlled by three project leaders of the chain “F 1”. This organisation aims at maintaining competition among the contractors and to increase learning. But learning effects were optimised because the client drove the process. It coordinated the renovation sites and elaborated tools (an operational guide presenting the procedures and the best practices) that favour learning. ACCOR Hotels is a major professional client. Because of its size and internal competences in building projects, ACCOR Hotels had the option of choosing work methods in the renovation process. If clients have preferences like this, they have to articulate their demands in the same way as e.g. ACCOR Hotels.

5. Conclusion: Reshaping boundaries

The purpose of this paper has been to analyse how the construction business system is being reconfigured as a result of the mediation processes between product characteristics and user requirements, and how the mediation processes reshapes the boundaries between companies, products/concepts and users. First, the results show that users do contribute to innovation in

construction. They may act as active agents in themselves or as representations through e.g. spokespersons or market surveys. Second, the co-production of companies, concepts/products and users reshape the construction business system in important ways when it comes to the organisational structure and boundaries within the company itself, between the companies, and between the companies and the users. The cases show examples of shifts and changes within the construction business system such as:

- Functions of design, coordination and workmanship, where parts of the function or the function as a whole shift between different companies or between companies and users.
- Division of labour and competence.
- Relations between the various actors, e.g. new partnerships, inclusion or exclusion of actors and new alliances.

In Table 1, the results are presented as three challenges and dilemmas. In conclusion, the mediation processes between product characteristics and user requirements put pressure on the existing boundaries between companies, concepts/products and users. If these rather temporary and fragile reconfigurations of the construction business system are to be sustained as a new industrial reality, it requires strategic decisions and commitment.

Table 1: Summary of key challenges and dilemmas..

<i>Challenges</i>	<i>Dilemmas</i>
<i>1. Who are the users?</i>	<i>End-users, representatives and/or stakeholders?</i>
<i>2. How can users and production systems interact?</i>	<i>Representation of users - directly or indirectly? Professionals in the construction industry in the double role as users and staff? The internet creates the opportunity for contact with new users, but can it be exploited?</i>
<i>3. How are the production system re-configured?</i>	<i>Re-configuration of external network of manufacturers? Re-configuration of the relationship between production and distribution?</i>

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