Exploring the Dynamics of Supplier Innovation Diffusion

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Abstract

Purpose – This study aims to focus on a reinforcement supplier's efforts to diffuse solutions, more or less innovative, in the construction sector to gain understanding of what facilitates and complicates innovation diffusion from a supplier perspective.

Design/Methodology/Approach – The interpretative research presented builds on 28 semi-structured interviews with the supplier and its customers and document studies. The research emphasizes dynamics in the diffusion process and rests on the assumption that the innovation content, innovation context and the innovation process interacts in the diffusion process.

Findings – The findings and the contribution from the study provide significant details concerning how the dimensions interact and how the diffusion process may unfold over time, but also that different solutions interact to push diffusion forward.

Research Limitations/Implications – The study relates to one supplier's work and the interplay implies uniqueness in different cases. Studies in other contexts could, therefore, also be suitable to develop findings and their transferability.

Practical Implications – The study provides understanding for suppliers diffusing innovations in construction on how to act.

Originality/Value – A major contribution from the study is that it puts emphasis on how the diffusion process proceeds in interaction with its content and context and problematizes this dimension. Furthermore, the importance of nuancing sub-contexts to display decisive factors in the diffusion process is emphasized.

Keywords Construction process, Diffusion, Interpretative position, Innovation content, Innovation context, Innovation process

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1. Introduction

Innovation diffusion (ID) research in construction management (CM) has placed substantial emphasis on actors controlling the construction process such as major contractors, end-customers and the institutional setting in which they operate. However, construction projects are often an inter-organizational, complex undertaking handling a number of

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components, people, organizations and locations (Dubois and Gadde, 2002), where suppliers are a significant part. Being innovative as a supplier can therefore create value and competitive advantages.

ID in construction most often requires implementation of innovations in projects (Winch, 1998) and knowledge to be spread between these projects (Senaratne and Sexton, 2008). The construction context on the other side is often characterized by a short-term perspective and fragmented processes (see for example Barlow, 2000, Widén and Hansson, 2007), with a focus to save time, take short-cuts (Miozzo and Ivory, 2000) under the influence of stress (Cattell et al., 2016). These issues in combination create a non-innovative business setting and a question arises: How do actors such as suppliers, working upstream in the construction process and most likely with limited power and influence, develop and diffuse innovations under these conditions? The aim of this exploratory study is, therefore, to gain an understanding of what facilitates and complicates ID from the perspective of a supplier in a construction industry context. As motivated in the methodology section, the research also aims to respond to criticism towards ID-research in CM lacking detail and not showing dynamics in the ID-process.

2. The supplier innovation diffusion context

This research views innovation as the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations. (OECD, 2005, p. 46). ID, i.e. communicating a new idea through certain channels in a social system regards the latter parts of the innovation process and relates to adoption, diffusion, implementation and consequences thereof (Rogers, 2003).

The influence of context on ID has been addressed extensively as criticism when over-simplified (Larsen, 2011) and as important in order to conduct valid research (Widén, 2006, Green et al., 2010). Although mainly found upstream the construction process, suppliers are also influenced by the project-based method. Perhaps of most significance is the appearance of contexts with different conditions when focusing on suppliers in construction. Suppliers, such as building material or component suppliers, are product-oriented and work in a continuous business that delivers to a (discontinuous) project based context (Larsson et al., 2006). This is of specific interest for ID, where knowledge creation and exchange is of central importance for diffusion to take place. The project-based work method causes discontinuous knowledge flows and re-establishment of knowledge flows as new projects start (Gann and Salter, 2000). Although continuous knowledge flows appear until project delivery, dependence on projects is important to consider for innovative suppliers. One negative factor for supplier ID is stress and risk-awareness in projects as it leads to choosing trusted and established methods and solutions to lower risk taking and is also leads to rejection of new ideas (Larsson, 1992, Emmitt, 1997).

Affecting ID is also the character and the impact of the innovation. Slaughter (1998), for example, categorizes innovations according to *the magnitude of change from current state-of-the-art* (p. 227) and *expected linkages of the innovation to other components and systems (p. 227)*. Magnitude ranges from incremental to radical. Linkages are treated through three innovation types (modular, architectural and system) and how it affects the construction process. Taylor (2006) studies' on innovations with inter-organizational impact (systemic innovations) relates the speed of diffusion to the scope of the innovation and how it fits into the current structure of construction. The extent of the innovation, for example, the complexity level of the change, how much it affects the process and the number of recipients

is major influencing factors on the diffusion process. This is, therefore, an important part in displaying a representative ID-process and hence of interest for supplier ID.

Harty (2005) divides innovations into bounded and unbounded owing to their sphere of influence. Unbounded innovations require adaptation towards different parties in the construction process. The implementation process differs between these classifications, owing to different implementation contexts. Furthermore, the content and aim of the diffusion process is modified in the implementation process. Harty shows a highly interactive process where changes and adaptations take place in several dimensions and unforeseen consequences appear. This latter example raises the diffusion process itself as a significant factor for diffusion, besides the ID-context and the innovation type in question. To conclude, to study supplier ID contexts with different conditions must be taken into account as well as the innovation type and the diffusion process.

3. Research Methodology and Design

Criticism toward ID-research in CM pinpoints a lack of detail on how innovation takes place (Harty, 2008) and how change over time takes place owing to complex and changing contexts (Shibeika and Harty, 2015). Need of additional insight into management of dynamics in construction (Laufer, Shafira and Telem, 2008). Çıdık, Boyd and Thurairajah (2017) as well as the necessity of managing technology, organizations and people in an integrated way are other central issues. This explorative research attempts to meet these issues using Pettigrew and Whipps' (1991) research on strategic change, which emphasizes interaction between context, content of and the strategic change process itself as explaining progress and outcome of the strategic change process. This is, in this research, adapted to exploring the interplay between ID context, innovation content (type of innovation) and the ID-process itself as explaining the outcome of the ID-process.

This research focuses on a reinforcement supplier's (RS) development and diffusion of three services:

(1) 3D-modelling/BIM, frequently considered an innovation (see for example Davies and Harty, 2013, Succar, 2009);

(2) QR, a software/system to list and specify reinforcement, considered a new system with new features making the service an innovation for its users; and

(3) color sorting and labelling, perceived by its users as providing a significantly new and simplified process, constituting an innovation.

Differences in scope and content makes these services suitable to compare how content, context and process interact and reveal both facilitating and complicating factors for ID.

The empirical collection was conducted in in two steps. The first step was inductive, enabling open-mindedness for the past and present RS business situation. This enabled increased possibilities to generate new research findings. It lasted about 6 months in 2013 and 2014. RS company documents, websites and 24 semi-structured interviews, which provided a structure for meaningful interviews/discussions and flexibility for arising themes of interest (*cf.* Andersen, 1994, Merriam, 1994), were conducted with RS (internal) and external respondents. Internal interviewees were managers and employees, from sales to delivery (marketing and sales, order administration, technical support, production/manufacturing and logistics/transportation). The 11 external interviews worked for contractors, where the services had the greatest effect, comprising purchasers, site/production managers, team leaders, project engineers, business area managers and project managers. All these respondents provided different perspectives of and from the

construction process. The questions on what has changed (content), how has it changed (process) and why has it changed (context) (Pettigrew & Whipp, 1991) were used as a point of departure in the data collection, in the analysis of findings adapted to the ID-process as stated above. Interview questions addressed the business situation of the RS (development, objectives and challenges), the character and context of the construction industry, its development, IT-related issues and detailed questions about the diffusion of the studied services. Interviews lasted 30 minutes to 2 hours, were recorded, transcribed and summarized (memo; *cf.* Corbin and Strauss, 1990) to form a first analysis.

To assess diffusion over time, a second round of semi-structured interviews were conducted with four RS employees working with diffusion-related activities; the technical manager, a sales representative, one team leader for the Building Information Modelling (BIM)/reinforcement engineers and one BIM/reinforcement engineer. Based on the first step data-collection, specific questions about the development and diffusion of specific services, to whom, why and under what circumstances were raised, and company information about the services were also overviewed. The time between the two steps of empirical collection enabled studies of consequences from the diffusion process, important for diffusion studies (Rogers, 2003) and improved internal validity of the findings (Merriam, 1994).

Grounded theory *inspired* the initial step of data collection and subsequent analysis owing to its suitability for generating new theoretical insights (Glaser and Strauss, 1967, Corbin and Strauss, 1990, Locke, 2001). It was also used to facilitate open-mindedness for the empirical material. Collected material was divided into groups of themes, (*cf.* coding and category-creation in grounded theory). Theme-creation have in general followed Guba and Lincoln (1981) criterion; number of people expressing a view, feedback from the "audience" about important matters, certain categories obviousness owing to uniqueness and approach that follows by the category. Summaries and analysis over time have then resulted in the findings presented here, where the interaction between content, context and process as applied on the ID-process in this research, has been a guide in the analysis of the findings, to explore dynamics in the process.

4. Findings

The RS is one of three reinforcement suppliers in Sweden and part of a worldwide company. Swedish and to some extent Scandinavian organizations (contractors) dominate the market (measured turnover) and are major customers besides retailers and prefab-manufacturers. The business context was characterized by just-in-time, high delivery precision and a focus on reducing unnecessary activities. Competition from low labor-cost countries has resulted in price pressure, creating a need to develop the business to become more competitive. When reviewing factors complicating diffusion, communication and openings for new or alternative solutions and ideas were hampered by stressful projects with tight deadlines in combination with a late entrance into the RFP-process for suppliers. A neglect of project evaluation and feedback (PEF) also limited innovation, making projects use established ways of working, reinforced by a behavior that minimizes risks and avoids new ideas and solutions. Furthermore, with the construction sector described as tough and conservative and with a lot of suspicion, this furthermore makes new ideas hard to release. Finally, lack of interaction in the construction process also disabled possibilities to create understanding for vital improvement areas.

However, owing to the variety of projects and their characteristics (for example, houses, roads and bridges), experiences might not be applicable between projects and important to consider regarding PEF. People may also transfer experiences between projects individually

without PEF. In addition, new ideas and solutions had to reach a certain level of maturity to minimize risk and be adopted. These factors help in explaining some of the obstacles for diffusion. On the other hand, facilitating diffusion were carefully and accurately planned projects with details solved before production-start as they enable communication about new solutions and ideas in combination with an early introduction into projects. External pressures and trends such as increased environmental thinking, decreased energy consumption and a safe work environment were also pushing a need for new solutions forward.

4.1. Studied services and their diffusion

The RS saw a potential in delivering solutions that improve overall construction process efficiency and in creating a position as a technically competent company to handle price pressure. This motivated development of the services studied and to diffuse these to customers:

- *3D-modelling/BIM:* The RS worked extensively with 3D-models/visualization and information-transfer between different IT-systems, providing electronically generated specifications lists, visual planning, visualization and documentation. The service also enabled increased sales of prefabricated elements and simplified manufacturing through visualization. This focused on several counterparts at customers.
- *QR (a system to list and specify reinforcement):* The RS had supplied the market with software for several years. By stopping development of the old version, users were forced into the new version. The new system was easily accessed with add-ons enabling electronic information transfer with an open file format and "cloud-based". When on-line, changes in different projects were shown immediately. Primarily useful for people working with reinforcement in different ways, the add-ons enabled a better overview of tasks and available resources, simplified access to documents and a shortened overall lead-time, increasing its usefulness for other parties.
- *Color sorting and labelling:* With this service reinforcement comes sorted and labelled for simplified assembly. It primarily addresses actors working with reinforcement on site. The RS has made several internal activities to make it work in the construction process, resulting in extra internal work but much of the internal development has simplified implementation and testing of the service in projects.

The RS have used and are using conventional selling efforts (sales visits, brochures, demonstrations for example). Owing to the lack of detailed operative productivity measures, quantified benefits have been hard to show with color sorting and labelling, complicating sales of the service. Therefore, the RS chose to diffuse the service without charge. The service was easy to understand and use, benefits showed directly and implementation on site was easy. After testing the solution, most users wanted the service for coming projects, thereby creating a need and a push from the projects for the service.

QR was developed and tested internally but development was more complicated than expected. Simplifications over time enabled a smoother diffusion process and better functionality. For both old and new users, the RS showed the software on site and made the start-up simple with an instruction video on YouTube, instead of a written instruction. Regarding diffusion of the more advanced BIM-related services, the second round of interviews clarified that more extensive and advanced services need more time and effort

from adopters and are thereby harder to diffuse, mainly owing to the lack of resources (time) and level of IT-maturity. Interest and age of potential users have a great influence and should be considered in the diffusion process. Growing up with IT as younger generations, for example, Facebook, cloud-solutions and information sharing through servers, makes IT natural to work with.

Reviewing the work taking place, the internal and external interviews stressed that the company was as a technically competent company, showing that the diffused service has developed the company's position on the market. Their services affected customers' processes positively and work conducted shows a good effect on the company's competitive situation.

5. Reflections and additional insights on the diffusion process and its progression

Reviewing the processes more in detail the innovation diffusion processes take place in an overall context where both facilitating and complicating factors affect the different sub-contexts of the three innovations in different ways. Each diffusion process and the interaction between content, context and process show different characteristics as they take place in different sub-contexts.

The overall business context interacts with all the studied ID-processes and detailed reviews display differences. With the original context of the coloring services, difficulties arose to motivate the price in negotiations with company purchasers, which led the company to diffuse the service free of charge. This change of context (removing company purchasers) made the diffusion process to take off, requiring no changes in content as its users saw the benefits. Regarding QR and by forcing users into the new system, i.e. the context was adapted to the new software. With uncomplicated content and implementation, the interplay between the dimensions was beneficial. Reviewing 3D-modelling/BIM, parts of it is easy to use and understand, while other parts require more work. Owing to the scope of the context that is affected, diffusion depends on more contextual factors for progress. Hence, it is possible to see how the dimensions interact here as well, with more content added, the affected sub-context increases, which in turn affects the ID-process. A key issue is review the interaction between content, the context or the process and assess if there is a need to adapt these factors, very much related to the scope or the extent of the innovation (*c.f.* Harty, 2005, Taylor, 2006).

The study also identifies the importance of managing the ID-process in itself, i.e. how diffusion takes place and is managed, providing relevance in to study the ID-process more in detail (see Harty, 2008). This is mostly shown by how approaches to diffusion have been adapted. The study also stresses that the perceived extent of and understanding for an innovation and the context differs among different people and/or groups implying a need for a mix of approaches for the "same" diffusion process. An example regards the BIM-services where maturity and age was stated as influential on the diffusion.

Implementation of innovations often occurs in projects (Winch, 1998) and spreading knowledge between projects is necessary for development and diffusion to take place (Senaratne and Sexton, 2008). Despite the apparent neglect of project evaluation and feedback, the case shows that diffusion to each project (context) can itself be a learning process leading to changes in who to address, how to address or if the content should be modified or changed for continued diffusion. With a good result and people realizing benefits, i.e. conducting a learning activity on their own, innovations can become diffused over several projects, i.e. a way to establish knowledge flows (*c.f.* Gann and Salter, 2000).

6. Conclusions

The aim with this research was to provide additional understanding and insights of the innovation diffusion process by studying a supplier's work with diffusing new services, viewed as innovations and gain understanding of what facilitates and complicates ID from the perspective of a supplier in an inter-organizational construction industry context.

The used approach, studying how innovation content, innovation context and the innovation diffusion process interact, explains the progress and the outcome of the studied ID processes. The study has shown the necessity to nuance sub-contexts in research; construction projects with regard to its type and character. Different contexts have differing characteristics that influence ID. Main enablers for diffusion relates to reducing complexity, here addressed as managing the extent of the innovations, the impact on the construction process and the ability to control. Reducing complexity and increasing control is furthermore reduction of project dependence (discontinuity) by moving activities into the continuous supplier context. Concerning practical implications, the study provides understanding for suppliers diffusing innovations in construction on how to act.

The study identifies differences in knowledge and maturity as influencing speed of diffusion in different groups, implying the need for different diffusion approaches for different target groups. A better understanding for when and why different approaches are used or useful, may increase understanding for ID in CM and the diffusion of different types of innovations. Furthermore, as the studied innovations interact and may act as "door-openers" for each other, this implies a potential to study an array of interacting innovations and their development over time. This would contribute with more understanding of ID from a supplier and inter-organizational perspective. As the study relates to one suppliers work and the interplay implies uniqueness in different cases, studies in other contexts could also be suitable to develop findings and their transferability (Lincoln and Guba, 1985).

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