Challenges of sustainability business innovation in built environment

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Summary

The climate mitigation is one of the greatest challenges of sustainability society. It has boosted the fastest growing new investment market in the world with 140 billion dollars yearly investments. The new market offers huge opportunities for sustainability business innovations. Inside the market, the built environment is assessed to offer wide scope of the most cost efficient opportunities. Paradoxically, most of the new sustainability innovations seem to come from other industries. The study was set to investigate what is the current approach in the real estate and construction industry to produce sustainability business innovation and why it does not seem to produce new innovation with required speed. Nearly a hundred innovation projects in the industry are reviewed and compared against the features of successful innovation processes. Unexpectedly, the results show that sustainability innovations process in the built environment seems to lack some key component of an innovation process. The sustainability innovation processes in real estate and construction industries were actually found to resemble traditional R&D processes instead of innovation processes. In the future, the sustainability business model development in the built environment should focus on innovation approaches and ensure that all the essential components of successful innovation development are in place.

Keywords: sustainability business innovations, climate mitigation, construction, open innovation, innovation framework

1. Introduction

In recent years, there has been a growing interest in understanding sustainability business innovation in built environment. Increasing global environmental challenges have turned public and private decision-makers worldwide to promote sustainability innovation and the application of energy-efficient technologies. Moreover, the potential market for sustainability business innovation is immense as the annual global sustainability investments exceeded 140 billion US dollars in 2009 [1]. While built environment is one of the largest segments in this market, it seems to be a disproportionately poor source of innovation. In the academia, several studies [2], [3], [4], [5], [6], [7] have looked at the barriers to and enablers of sustainability innovation in built environment. However, most of these studies only address the implementation of new ideas and the management of the implementation process. In fact, although the importance of innovation has been recognized in the sustainability innovation literature, there is a lack of research which addresses the sustainability business innovation processes that could help to explain and alleviate the difficulties of built environment to produce innovations.

In the general innovation literature, the service-dominant logic (S-D logic) is a new approach that
has emerged to explain modern innovation process – especially discontinuous innovation – the engine of economic growth. The S-D logic studies e.g. [8], [9], [10] suggest that the improvement in innovation process can reduce the time-to-market for innovations and facilitate the application of new technologies. While S-D logic focuses on intangible resources, goods and tangible resources are not ignored; interestingly S-D logic views goods as tools or appliances in the customer’s service provision process [9]. In contrast to the traditional R&D process, the S-D logic underlines the importance of customer role, value network, and resources which involve the value creation process for modern innovation process [9], [10]. Moreover, the S-D logic based innovation process is well-aligned with the principles of the open innovation paradigm [11], [12], [13], which emphasizes the balance between external and internal knowledge in the innovation process.

By creating a theoretical framework for sustainability business innovation and analyzing the project data from 93 innovation projects partly funded by the Sustainable Community Programme of the Finnish Funding Agency for Technology and Innovation (Tekes), we aim to shed light on the current approach in the real estate and construction industry in their aim to produce sustainability business innovations. In this exploratory research, our particular focus is to identify the key elements and structures of the innovation processes utilized in these projects, and compare the findings to the theoretical innovation process framework that we have developed based on established literature. In effect, this comparison contributes to mapping out the reasons why the current approach does not seem to produce innovations with the required speed and provides a systematic approach for exploring potentially unique characteristics of sustainability business innovation process.

Comparison between the theoretical innovation process framework and the project data is conducted with two main steps. The first step includes categorization of the project data according to the innovation characteristics defined in the theoretical framework. Second, results will be compared with project-data from two other similar Tekes programmes, but concerning other industries and field of innovation. This helps us to better understand the general result of this data set by having a reference point from other areas of innovation.

The paper is divided into three sections. First, we offer a theoretical framework for sustainability business innovation analysis. Second, the empirical project data and observations are discussed. Finally, the key research implications are presented with suggestions for future research.

2. Theoretical framework

The theoretical framework of this paper is based on the literature of innovation processes. The relevant literature can be divided into three main directions. First, we concentrate on the conventional line of research that has focused on the traditional R&D process and innovation in closed systems. Second, we review the recent numerous studies that investigated service-dominant innovation processes and open innovation. Third, most scarce but interesting field of the accessed literature is the increasing field of sustainability innovation literature. In the following section, we review some of the key themes of the above identified streams of innovation knowledge to provide a theoretical foundation for our sustainability business innovation framework.

2.1 Closed innovation and the traditional R&D process

The closed innovation model can be seen as the conventional industrial approach, in which the innovation process is a traditional goods-dominant research and development process. According to earlier studies [9], [11], [12], [14], [16] the cornerstones of the traditional R&D process are detailed planning, stage-gate decision-making, and a mode of operation where the innovator operates under secrecy i.e. tries to impede others to participate in the new innovation throughout the R&D process. In fact, the success of the traditional R&D process is based on developing in-house technological capabilities and intellectual property that enable the creation of new products. In addition, customer role in the R&D process is exogenous and the innovator does not rely on external sources and channels of innovation. The traditional R&D processes are often linear pipeline-models, where a number of product ideas are first submitted to technical and market assessment, and then the survived ideas are transferred into projects in the research and development pipeline. And finally, only few of the original product ideas are actually converted into
A good example of a traditional R&D process is a stage-gate process [15], [16]. Stage-gate systems use product manufacturing process methods to manage the innovation process – they build on development stages and decision gates between the stages. R&D process starts from a set of R&D ideas and is divided into a predetermined set of five stages: 1) preliminary assessment of potential R&D ideas, 2) detailed investigation of the selected idea, 3) development, 4) testing and validation, 5) full production and market launch [15]. The approach does not describe the generation of product ideas, except that they are invented in-house.

In the era of widely distributed knowledge and competences, the traditional R&D process has been scrutinized for making innovations more incremental [17], i.e. small improvements that add value to the product or service, than discontinuous innovations and providing very limited options for creating new business opportunities. For example, according to Cooper et al. [18] discontinuous innovation projects need very different type of management compared to traditional R&D projects. First of all, discontinuous innovations are often the foundation or platform for a new product line or an entirely new business. Moreover, discontinuous innovations should be managed differently because traditional R&D product processes are designed for fairly well-defined and predictable projects. In contrast, discontinuous innovation processes are often high-risk projects by nature, with many unknowns and great technical uncertainties. Furthermore, Miller [19] argues that effective innovation management requires two different types of processes for incremental and discontinuous innovations: normal linear gate-model for incremental innovations and spiral process for discontinuous innovations. Companies have to choose the right process-model from the scale between traditional linear stage-gate-model and complex spiral model. According to Assink [20], the innovation process should support an open innovation process in order to produce discontinuous innovations.

2.2 Open innovation and service-dominant innovation process

The open innovation paradigm argues that innovation is based on both internal and external ideas [11]. Consequently, the foundations of the successful innovation process have shifted from the capability to develop technologies in-house, to the capability of monitoring the external environment, of setting-up relationships with different actors – suppliers, competitors, other non-competitive firms, public research organizations, and end-customers – and of integrating several knowledge components [13], [21]. Moreover, a successful innovation concept recognizes the proactive role of intellectual property management, which facilitates the use of market to exchange valuable knowledge and enables alternative commercialization routes for innovation project results [14].

In the context of the open innovation paradigm, the S-D logic innovation theory [8], [9], [10], [22] has emerged to explain the discontinuous innovation process by removing the artificial distinction between product innovation and service innovation, and by focusing on the customer’s role. The key arguments behind the S-D logic are that goods are merely distribution mechanisms for service provision and hence the traditional R&D processes overlook major discontinuous innovations that are the growth engine of the modern economy. According to Michel et al. [9] the S-D logic defines an innovation discontinuous if it changes both the way the innovating organisation creates value and at least one of the innovation’s customer’s roles. In effect, the change in value creation can take place in how the organisation embeds operant resources in to objects, integrates resources or reconfigures its value network. Moreover, the discontinuous innovation changes the ways how the customer uses, buys and pays for a service.

The S-D logic approach provides a highly customer-centric view for analyzing, managing and developing innovation processes. According to Vargo and Lusch [8], the innovation development should always be strategically targeted at a specific customer need, and the value proposition embraces the customer’s co-creation on value. In fact, the value of innovation is defined by and co-created during the innovation process with the consumer rather than the embedded in output. Moreover, Lusch et al. [10] argue that the integration of the innovator’s value network is an imperative asset of the innovation process in tackling several key questions in the development of
innovation such as what is the most effective way to bring suppliers and customers into the service or product design process and how can one reframe the value network to speed up innovation processes? In a sum, the S-D logic highlights the importance of a strong customer and an extended value network involvement for a successful innovation process.

In line with the S-D logic paradigm, an empirical study on service innovation processes by Toivonen et al. [23] found that new service innovations are often created by utilizing knowledge and competence across industry borders and that the development of the service innovation is highly dependent on the successful relationship to pilot clients and other early clients. In addition, the study documented that the rapid application innovation process was the most prominent innovation process among the innovation cases studied.

The rapid application service innovation process provides an example of an innovation process aligned with the key principles of open innovation and service-dominant logic. Rapid application of innovation takes place by converging market entry, production and development. The process can be divided into three phases: 1. producing the idea (together with the customer), 2. applying the idea in practice, 3. developing the idea further [23].

Exogenous factors are an important input in the modern innovation process, especially in the case of discontinuous innovation. According to Assink [20], contrary to linear, incremental innovation processes, such as the stage-gate concepts, discontinuous innovation is more like a spiral or circular development process of selecting, exploring and experimenting with continuous fast feed-forward and feed-back loops. This process is affected by exogenous determinants such as economic, social and political factors, competition and infrastructure, and endogenous determinants such as resources, corporate structure and corporate culture.

Finally, a successful innovation concept needs for an integrated innovation strategy. The innovation strategy defines how the company should manage innovation process and elements [24]. A strong customer orientation would seem to be a key ingredient in a service-dominant strategy.

2.3 Sustainability innovation studies

Importance of innovation has been recognized in the sustainability innovation literature. Most of these studies concentrate either on identifying the drivers and barriers of sustainability innovation or address the timing implementation process of new ideas. However, there is a clear lack of research on the systematic analysis and modelling of the characteristics of the sustainability innovation process.

Regulations play an important role in construction innovation as the binding nature and usage of regulations can hinder the diffusion of innovative solutions that exceed the current state of the art. Dewick and Miozzo [2] look at the paradox between innovation and regulation and its implication for the adoption of sustainability technologies. Using thermal insulation as an example, the authors analyzed the underlying innovation process of sustainability technologies and documented the principal factors inhibiting and facilitating their adoption, highlighting the fact that both innovation and regulation are needed to create a more sustainability future for the construction industry. In addition to the inherent conservatism in the construction industry, additional barriers inhibiting the diffusion of new sustainability thermal insulation technologies include capital costs, the failure of the market to account for social and environmental costs and savings, and the perceived cost-effectiveness and performance of products over a 50-year lifetime.

Hartmann [5] has created a framework of construction innovation management to examine the relationships between innovation performance and environmental and instrumental variables of construction innovation. The approach differentiates between four potentials of realizing innovation in built environment: the potential of solving problems, the potential of diffusion, the potential of differentiation and the potential of implementation. The implications are that the management of construction firms should promote innovative ideas explicitly, make conscious strategic decisions about the direction of the firm's innovation activity and provide methodical and hierarchical support during the innovation process.
Binder [7] argues that within the context of the building sector, inter-organizational relationships are determinants of innovation. To explain the dynamics of these relationships, an evolutionary social learning model is proposed especially to implement sustainability innovations. A case study of the development of a tool designed to make builders select more sustainability building materials is presented and analyzed to illustrate an evolutionary social learning model of innovation. The social learning model suggests that sustainability innovation is a function of the perceived adaptiveness of the particular innovation by a particular habitus. Moreover, timing of the innovation development and market entry is a key determinant in the sustainability innovation process.

2.4 Sustainability business innovation framework

Based on our literature review, we propose the theoretical framework illustrated in Figure 1 for analyzing sustainability business innovation projects. The sustainability business innovation (SBI) framework comprises three key components of a sustainability business innovation concept based on the literature reviewed on innovation processes: a) innovation project target i.e. incremental or discontinuous, b) customer involvement and c) value network involvement. The value network component includes regulatory authorities, which was observed specifically, since it is emphasized by many authors as a key factor in sustainability innovation. Moreover, the SBI framework acknowledges the impact of both external factors - political, economic, social, technological (PEST) and competition, as well as internal factors – resources, strategy, organization and culture – to sustainability business innovation. Finally, the actual innovation processes are divided in four categories in our framework according to literature: Traditional R&D process, Innovation process following open innovation and service-dominant logic, Sustainability business innovation process and miscellaneous for those studied processes which do not suit to any of the previous categories.

3. Empirical data and empirical observations

This chapter presents empirical observations based on studied innovation processes and classifies the observations using the proposed SBI framework. The chapter is divided into three parts:
presentation of the data used, research design and finally the results of applying the SBI framework for the empirical data.

3.1 Presentation of the data used

The data used in this paper contains publicly available project descriptions (www.tekes.fi) from 93 innovation projects partly funded by the Sustainable Community Programme of the Tekes. The original Tekes data files sort the projects into two sets: projects generated mainly by research organisations and projects generated by enterprises. The data used includes both sets totalling in 31 research institute and 62 enterprise projects. The data contains four main initial data types, i.e. name of the project leader organization, project budget, the amount of Tekes funding, and an informal abstract describing the key idea of the project.

Project abstracts appear to be an interesting source of sustainability innovation information. They should by definition contain all the essential information on project targets, potential customers as well as customer benefits and partners. Moreover, as the abstracts are generated by the innovation project leaders from the executing organization they should nicely describe their perception of the most important success factors of the innovation project. Consequently, it is proposed here that the abstracts provide actually a better picture of the aims of the projects than the other more formal parts of the Tekes funding application since the open form of the abstract does not influence the content of the text.

3.2 Research design

We will employ discourse analysis to analyze Tekes project data relative to our theoretical framework. Primarily the project abstract data is scanned to find out whether they contain the three components of the theoretical successful sustainability business innovation concept. First, we interpret whether the project abstract suggests a discontinuous innovation by analyzing the aims and descriptions of the project. The key variable is whether the project suggests a change in value chains of the provider or the customer behaviour. Second, customer involvement in the innovation process is analyzed by looking whether the “customer” or “user” is identified in the abstract, or alternatively whether a strong customer involvement can be read from the aim of the project. Third, we study the value network involvement by looking for the presence of “partners”, “co-operation” and “regulatory authorities” in the abstracts. Finally, the results are compared with project-data from two other Tekes programmes.

3.3 Interpreting the project data with SBI framework

3.3.1 Characteristics of studied SBI projects

Based on the overall observations of the SBI projects studied it seems clear that the great majority of the projects are not targeted at discontinuous innovations. In effect, according to our project data classification by SBI framework, only 2 % of all scanned projects engage all features of discontinuous innovation (i.e. changes in both value networks of providers and the customer behaviour). However, some characteristics of discontinuous innovation were identified in 38 % of the projects. More specifically 22% aimed for changing customer behaviour and 15 % for development with provider value network constellation. Changes in the customer behaviour were mostly signalled in the used data by the presentation of a targeted consumer group or by identifying BtoB customer’s new role in the product under development. For example, some projects assume behavioural changes by the consumers in their energy-use or product selection criteria. In contrast, changes in BtoB environment were usually signalled to take the form of adopting a new planning method. Moreover, changes in the value network were indicated by new business models or creation and introduction of totally new products or services to the market. Interestingly none of the scanned projects included all of the three sustainability innovation components and only 3 % of the projects included at least 2 of the 3 core innovation components. Majority of the projects included only 1 innovation component and a fundamental 46 % of the projects lacked all the innovation components.
As new innovations are required according to theory include all the core elements of discontinuous innovation, a clear majority of the projects could be classified as non-discontinuous innovation projects. In essence, 98% of the projects were non-discontinuous innovations involving only incremental innovation or other strategic objective (categorized in the SBI framework as miscellaneous), such as, strategic marketing survey, or strategic development of the organization. Most of the projects (83%) had the characteristics of incremental innovation projects that typically employ traditional R&D processes to generate a minor improvement in the status quo of a service, product or process. Furthermore, 8% of the projects aimed for strategic development of the organization such as integration of the sustainability dimension in organization’s strategic and employee competencies. In addition, we found that 7% of the projects seemed to be concerned with strategic marketing surveys or research discussing the current market situation or research needs.

The data analysis suggests that the customer and value network involvement component of innovation appears to be missing from most studied projects. In practise, customers were identified to have a strong involvement only in 12% of the projects, and typically it was inherently included into the nature of the project, e.g. surveys or feedback system development, and not in the main objective of the project. Furthermore, the end user participation was indicated explicitly only in 3% of the projects. Finally, the value network involvement component was found to be present to some extent in 44% of all projects. Moreover, 20% of these contained only one single stakeholder in value network namely regulatory authorities.

When analysing the results by the type of project organisations, the results reveals that projects led by research institutes have the highest relative frequency of innovation components. In effect, 76% of the projects led by research institutes possessed at least one of the core components of successful innovation, whereas the same for the enterprise projects was bellow 50%. By further dividing the set of organizations into four categories – SME companies, large companies, public organizations – we found that public organizations had reported at least one innovation component in 58% of projects, large companies in 50% and SME companies in 43% respectively.

Finally, an interesting notion was made that the size of the innovation project does not seem to correlate with the number of core innovation components in the project. A comparison of the size of the project’s budget against the number of innovation components in the project suggests that a large project budget does not seem to guarantee the presence of core innovation components. In fact, the size of budget and the amount of the core innovation components did not correlate at all in the data analyzed. For instance, the innovation project with the smallest budget had two innovation components whereas the project with largest budget did not include any innovation components.

3.3.2 Comparison of results with other innovation projects

Here we compare the results from our primary data set with a secondary testing data set from two other Tekes programmes, FinNano and Water. The comparison was challenging because the nature of Sustainable Community Programme projects differs considerably from FinNano and Water programmes. In spite of this, our analysis indicates that projects in FinNano and Water generally seek to create totally new products or services and, therefore, indicates to look for more discontinuous type of innovations. In contrast, the projects in Sustainable Community programme aimed more at incremental development of the sustainability parts of product and services, and to comply with upcoming legislation. However, similar to Sustainable Community project, the projects of FinNano and Water did not typically include all three key innovation components as customer involvement and value network involvement were frequently missing. Finally, the data comparison with other Tekes programmes indicated that the analysis method applied in this study can be used context independently and strong industry and technology domain expertise is not necessary.

4. Discussion and conclusions

The study was set to investigate what is the current approach in the real estate and construction
industry to produce sustainability business innovation and why it does not seem to produce new innovation with required speed.

After covering the relevant theories on innovation processes, a theoretical sustainability business innovation (SBI) framework was created comprising three key components of a sustainability innovation concept: discontinuous innovation project target, customer involvement and value network involvement. Following that, a set of 93 projects with the total budget of over 42 million Euros from Tekes Sustainable community programme was scanned against the framework.

The main findings suggest that the key components of a successful sustainability innovation are mostly missing from the studied innovation projects. We found that none of the scanned projects include all of the three key innovation components. Moreover, a majority of the projects include only one innovation component and a surprisingly high 46 % of studied projects lack all the innovation components. Most importantly, the innovation projects in the data set would not seem to be targeted at discontinuous innovations. Instead, 98 % of all projects appear to be involved with incremental innovation, strategic marketing surveys, or strategic development of the organization. In accordance with earlier studies, our findings seem to indicate that regulatory authorities are an important factor in the sustainability innovation process. Furthermore, our data analysis shows that the project budget size would not appear to correlate with the number of key-innovation components in a project. Surprisingly, projects led by research institutes and public research organisations contain on average a greater number of innovation components than enterprise projects.

When generalizing based on the results, this study has some important limitations. Since the data for the study is limited to project abstracts, the implications made should consider as suggestive only. The project abstract data used does not contain detailed information on the innovation process. Furthermore, the Tekes data does not necessarily represent the actual sustainability business innovation environment. For example, the Tekes funding criteria may create a biased picture of the sustainability innovation environment as all innovative organisations do not apply for Tekes funding.

This paper sets forth several leads for future research. It would be highly interesting to study further the reasons behind the challenges in sustainability innovation. Moreover, more research attention should be given to identifying the potentially unique characteristics of sustainability innovation process. Finally, the results in this study could serve as basis for further research concentrating on the decision-making process and criteria of funding organizations in the area of sustainability innovation.

5. References