Author(s): Sivunen, M., Kajander, J.-K., Heinonen, J., and Junnila, S.

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Matti Sivunen
Research

Aalto University School
of Engineering, Real
Estate Business REB
Finland
matti.sivunen@tkk.fi

Juho-Kusti Kajander
Researcher

Boost Brothers Ltd
Finland
Juho-kusti.kajander
@boostbrothers.fi

Researcher Jukka Heinonen, Aalto University School of Engineering, Finland,
jukka.heinonen@aalto.fi
Professor Seppo Junnila, Aalto University School of Engineering, Finland, seppo.junnila@aalto.fi

Summary

The climate change mitigation is one of the greatest challenges of sustainable society. It has boosted the fastest growing new investment market in the world with over 140 billion dollars yearly investments. Inside the market, the built environment is assessed to offer wide scope of the most cost effective sustainability business innovation opportunities. Paradoxically, the climate opportunity in the real estate and construction sector (REC) has not activated sustainability business innovations (SBI) with required speed. The latest research seems to imply that the industry utilizes traditional R&D process that is not most suitable for fast radical innovations.

The study was set to investigate what are the challenges of sustainability business innovations in REC industry in Europe and what are potential SBI solutions to tackle these problems. Three groups of international professionals were interviewed to give more specific understanding of sustainability innovation challenges in built environment. Unexpectedly, the main findings of this paper suggest that SBIs in REC have several industry specific major challenges. The key challenges appear to be complex REC industry value network, team building, high R&D-intensity, and commercialization management. In addition, the following themes were identified: SBIs in REC industry are constrained by project business orientation, fundraising and internationalization issues and lack of regulation, standards, customer pull and incentives. Moreover, several potential solutions were identified such as national policy decision-making round table and SBI valuation investor tools. In the future, it would be highly interesting to study further the role of VC and policy decision maker in creating SBIs in built environment.

Keywords: Sustainability business innovations (SBI), real estate business, construction, built environment

1. Introduction

The climate change mitigation is one of the greatest challenges of sustainable society. Climate mitigation has boosted the fastest growing new investment market in the world with over 140 billion dollars yearly investments [1]. Inside the market, built environment and especially the real estate and construction (REC) industry is assessed to have the largest potential for profitable environmental burden reduction [2]. There is a lot of evidence to support the belief that in order to rapidly increase sustainability in built environment the radical innovation is essential. In fact, innovation has recently been emphasized in general environmental economics literature and has

been defined for example as technical environmental innovation, eco-innovation [3] or sustainability business innovation (SBI) [4] – innovations that bridge the gap between business, social, and environment factors to achieve sustainability. Perhaps the most challenging aspect of the climate mitigation is the short time frame for corrective actions, specifically in built environment for example to produce almost zero energy buildings by year 2020 – in ten years [5]. Paradoxically, the latest research suggests [4] that despite the sustainability opportunity there is little SBI activity in REC industry. In particular, there is a lack of fast customer-oriented radical innovations that are expected in sustainability markets. In addition, the very few radical SBIs already in the market face great challenges in being accepted by investors and other stakeholders [6].

The study was set to investigate what are the challenges of sustainability business innovations in REC industry in Europe and what are potential SBI solutions to tackle these problems. First, a thematic framework for SBIs in REC industry is utilized to identify relevant themes, and then several professionals from public and private venture financing organizations, REC industry companies, and research organizations are interviewed to increase the understanding of challenges specific to SBI in REC industry. Moreover, we analyse the challenges at venture capital (VC), company, and policymaker perspectives, and several SBI experts are interviewed to identify potential solutions for these challenges.

The paper is divided into three sections. First, we briefly review the key themes of innovation challenges in earlier literature. Second, the empirical data from interviews and observations are discussed. Finally, the key research implications are presented with suggestions for future research.

2. Challenges to innovation

2.1 General and REC industry's innovation challenges

General business innovation challenges have been widely studied in last decades. The literature review concluded that key challenges to innovation are related to efficient team building, innovation strategy and processes, organizational culture, and lacking resources for innovation. For example, West and Callagher [7] have documented that the key challenges of innovative companies are building and motivating the best and brightest team for the innovation, exploring a wide range of external sources for innovation, integrating those sources with company's resources and capabilities, and maximizing returns on intellectual property. Moreover, several studies [8-10] have investigated business innovation processes and suggest that a low level of customer and value network integration into the innovation process represents a challenge to business innovation, especially service-oriented radical innovations. Holmström [11] argues that large size of the organization per se is a great challenge to business innovations as it often leads to bureaucratic internal organization of the firm and myopic management behaviour due to concerns for reputation in the capital market. Therefore, small companies innovate disproportionately compare to large companies, and contrary incumbents often fail to innovate due to their bureaucratic organizations that compromise innovation incentives. Moreover, Chesbrough and Crowther [12] have identified not-invented-here (NIH) syndrome and lack of internal commitment as main hampering factors of business innovations.

Several studies suggest that there are various industry specific challenges to innovation in REC industry. Construction innovation is traditionally identified as technical innovation that increases the feasibility and quality of construction projects [13-14]. Innovation in the REC industry is often classified as a cost-intensive investment with very indefinite returns due to the risks associated with R&D and great variations in both demand and profits [15-16]. In addition, recent studies [15-17] suggest that the lack of innovation management competencies and tools – especially related to promoting new ideas and making conscious strategic decisions about the direction of the firm's innovation activity – present a challenge to innovation in REC industry. Innovations in the REC industry have a tendency to be incremental in nature, and lead to radical transformations only over the long-term.

2.2 SBI challenges

Earlier literature does not contain extensive studies concerning SBIs especially in REC industry, and the studies have focused on the role of the regulatory authorities. For example, Dewick and Miozzo [18] research the relationship between innovation and regulation in the context of energy efficiency and REC industry. They find that besides the inherent conservatism in the REC industry, additional barriers inhibiting the diffusion of new SBI 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. Moreover, few recent studies have looked at why radical sustainability innovations often fail in REC industry in spite of their strong ecological and efficiency benefits. For instance, Rennings et al. [6] have examined SBI challenges in the context of power plant construction. The authors identified high investment costs as a barrier for introducing radical product innovations.

Recent studies have also looked at the policy decision-maker challenges concerning the development of policy processes for sustainability innovation. For instance, Foxon and Pearson [19] argue that the incorporation of dynamic innovation systems thinking beside traditional linear innovation models and the need for a long-term strategic framework to address sustainability concerns has direct implications for the development of sustainable innovation policy. Moreover, increasing demand of new sustainable innovations is also recognised as key challenge for policy makers to promote new SBIs. Utilizing public procurements methods or reinforcing standards and regulations are identified as key tools increasing SBI demand [20]. According the latest research need of new SBI decision-makers tools is critical. For example in Finland, the consequences of current ecology policy activities are recognised as development of organizations present processes and slightly the diffusion of new SBI, but not generating new sustainability innovations [21]. Fundamentally, regulation dictates innovation adoption. Relaxed climate policy is a challenge to radical innovations and has led to the era of incremental solutions [6].

Furthermore, Kajander et al. [4] investigate the current approach in REC industry to produce SBI and why it does not seem to produce new innovation with required speed. Almost hundred innovation projects in the industry were scanned to find out whether they contain the major components of an innovation process – radical innovation target, and strong customer and value network integration into the innovation process. The results implied that sustainability innovations process in the built environment lacks some of the key components of an innovation process as none of the scanned projects included all three components. Moreover, the sustainability innovation processes in REC industry were actually found to resemble traditional R&D processes instead of innovation processes.

3. Empirical data and research design

The empirical data was collected from three-round interview and analysis process. Some preliminary results from round one and two interviews will be published forthcoming LCM2011 conference in Berlin. In round-one, we collected data through theme interviews from venture financing organizations that invest in SBI in built environment. In round-two, we interviewed five representatives – 2 CEOs, 2 chairman of the board and a technology director – from REC industry companies active in SBI. In round-three, we interviewed three professors from Europe's top Universities to validate our findings on neutral environment and against findings in innovation research from round 1 and 2, and to investigate the challenges at policy level and explore potential solutions to overcome SBI challenges.

The target of the first three interviews was to find out what are the key challenges of SBIs from venture financing organization's point of view and how they differ from general innovation challenges. The challenges identified from earlier literature were used as grounding structure of semi-structured interviews. The three interviewed VC experts come from venture finance organizations based in Finland that have altogether over 480 Meur of funds allocated in investments in SBIs in built environment, especially in renewable energies and energy saving technology companies in Finland but also other European countries.

The round-two five interviews were conducted by interviewing REC industry companies active in SBI. The target of these interviews was to find out what the key challenges of SBI are from the innovator's point of view and how they differ from general innovation challenges. All the offices of the interviewed professionals were located in Helsinki Metropolitan area. Each of the theme interviews lasted approximately two hours. Interviewed companies are presented in Table 1.

Table 1 Interviewed companies in round-two

Company	Company's scope	Market area	Turnover	Ownership
A	Sustainability engineering company	Nordic countries	70 MEUR	Publicly-listed
B	Development and manufacturing steel structure solutions	Global	610 MEUR	Publicly-listed
C	Indoor environment products, systems and services	Global	150 MEUR	Privately-held
D	Modular products for buildings	Finland	1 MEUR	Privately-held
E	LCM Services	Finland	4 MEUR	Privately-held

The target of the three round-three interviews was to validate the challenges identified from earlier interviews on neutral environment and against findings in innovation research. Moreover, secondary target was find out what the SBI challenges are from policy decision-makers' point of view, and finally, identify potential solutions to overcome SBI challenges. The interviewed three SBI researchers came from distinguished universities – IMD, EPFL and EHTZ – in Switzerland. Each of the researchers had over 20 years of experience in the area of venture financing to SBI innovations, construction and real estate innovations, or commercialization of SBI. Researchers had also strong experience from the industry e.g. commercialization of successful SBI's around Europe in role of entrepreneur and VC, and managing the leading global innovation consultancy company. Each of the semi-structured interviews lasted approximately three hours.

4. Results

4.1 Round-one interviews: venture financing organizations investing SBI

In round-one interviews all of the respondents stated *complex REC industry value network* as the key challenge to SBI. Taking new SBIs, especially radical, to the market is difficult due to REC industry value network fragmentation, as multiple stakeholder commitment and acceptance are required to go further in the innovation process. *Team building* was also brought up by every respondent as a particular problem of SBI especially in terms of lack of multidisciplinary entrepreneurial teams capable to manage complex value networks and innovation. Moreover, the interviewed experts underlined that SBI in REC industry typically needs a *long-term research and development (R&D) background for innovation*. Finally, *pending regulatory decisions* regarding energy efficiency standards was generally seen as a barrier to SBI in REC industry. In addition, some respondents mentioned SBI company *local market orientation* and consumer environmental awareness building as constraints on SBI in built environment.

These interviews suggested that the key challenges to SBI in built environment from venture investor's perspective are complex value networks, team building challenges, long-term R&D requirement and linkage with pending regulatory decisions.

4.2 Round two interview: active SBI companies in REC industry

In round-two interviews, the REC companies described several challenges inhibiting their SBI activities, which are summarized in Table 2. Most of the challenges identified in round-one interviews were present at the interviewed REC industry companies active in SBI. However, the companies also brought up challenges, which were not discussed in earlier literature or round-one interviews.

Complex value network in REC industry was mentioned as a challenge to SBI in every company interviewed. SBI activity within REC industry was regarded as a challenging long-term process that requires formidable investments and managerial tools to build and manage networks in a fragmented environment, especially in the case of radical innovations.

Table 2. Summary of round-two interviews

Company	A	B	C	D	E
Complex value network	X	X	X	X	X
Team building	X	X	X	X	X
R&D and commercialization management	X	X	X	X	X
Project business orientation in REC industry	*X*	*X*	*X*	-	-
Internationalization of SBIs	-	-	*X*	*X*	-
Fundraising	*X*	-	-	*X*	*X*
Regulation and standards	X	-	X	-	-

As table 2 shows, all interviewed company representatives argued that SBI *team and competence building* is a critical challenge especially concerning attracting the professionals who are development-driven and building teams with multidisciplinary competencies. In addition, several challenges related to *processes and tools of R&D management,* as well as *commercialization of research results* were present at all interviewed companies. Furthermore, some of the respondents pointed out SBI challenges related to *project based operations in REC industry, internationalization of SBI, fundraising for SBI, and lack of a common understanding on sustainability, innovation and environmental standards.*

4.3 Round-three interviews: Policy decision-makers in REC

In round-three interviews findings from earlier two rounds were verified as applicable also in Switzerland, and further suggested to be key challenges, more generally, for SBI in Europe. All interviewees argued that *fragmentation and long value chains* means complex value networks, which may become critical challenge to diffuse new SBI's inside the REC industry. Moreover, all of the interviewees mentioned *marginal competition*, focus on *incremental innovation*, lack of *commercialization competence*, and convincing *property investors* and local *policy makers* of SBI benefits as challenges.

Interestingly, *new regulation*, followed by *incentives and customer pull*, were identified as primary drivers of SBI production and implementation. Interviewees argued that regulatory development and sustainability promotion is primarily a duty of the government. In addition, firms should actively lobby for new regulations and thereby increase the demand of new SBIs. Lobbing was mentioned to be one of the key challenges in REC industry, as lobbing is not currently focused on increasing sustainability, but maintaining current business benefits. Especially production of radical SBI was identified as highly dependent on the speed of developing and setting new regulations. All interviewees argued that correctly arranged incentives are critical drivers of SBI as concrete out of pocket costs and benefits are crucial both b2b and b2c SBI. Moreover, regulatory authorities should develop tax credits, subsidies and other concrete benefit schemes to end users of new SBI and companies should create and visualize win-win-win situations and schemes for value networks. Finally, customer pull, in terms of consumer organizations and awareness and communication via media, was identified as potentially substantial driver but having currently relatively small role in practise on SBI.

In addition of identified challenges, interviewees presented some potential decision-makers solutions to increase SBI activity in REC industry. First, creation of national *round table decision making concept* for multiple public, private and 3rd sector stakeholders might be a potential solution to tackle complex value network. Round table would aim to develop and diffuse SBIs and effectively coordinate investments to focus areas and, therefore, could radically develop SBI generation in REC industry. Second, *SBI process development and implementation* was

developed as solution to SBI challenge of project based business. The main characteristic of SBI process include holistic approach to project design, building multidisciplinary project teams, implementing expertise and dedication to innovation inside the core team and focus on professional SBI project coordination. Finally, co-operation and research result implementation with global companies, creating from science to business SBI culture in universities, development and implementation of new SBI valuation investor tools and development of intelligent SBI tools for cities were mentioned as potential solutions.

4.4 SBI challenges in REC industry

Next we reviewed the findings from our three-round interview and exploratory empirical study. The challenges of the venture financing organization active in SBI, the companies active in SBI, and SBI policy decision-makers are presented and summarized in Table 3. The challenges identified for SBI in REC industry were categorized under the nine themes of complex REC industry value network, team building, R&D and commercialization management, project business orientation in REC industry, internationalization, fundraising for SBI, incentives, customer pull, and regulation and standards.

Table 3. Summary of empirical observations from interviews

SBI REC challenge	SBI VC investor challenge	SBI industry and company challenge	SBI policy decision-maker challenges
Complex value network management	Complicated and costly decision-making processes	How to find the right partners and projects for SBI and convince multiple stakeholders of the SBI benefits at the same time?	How to manage systemic change in a fragmented environment?
Team building	Lack of multidisciplinary and entrepreneurial teams	Lack of innovation management competencies	
R&D and commercialization	- Long-term R&D required for SBI - Time gap from product to market with high sunk costs	Lack of processes and tools of R&D management and commercialization	- Marginal competition in the industry - How to create science-to-business culture?
Project business orientation in REC industry		-How to create an innovation culture in a project organization? -How to convince risk-averse project participants on SBI?	How justify local investments to voters?
Inter-nationalization of SBI	SBI company local market orientation	- How to create a company innovation culture for transferring SBIs in different locations? - How to make regional business to strive for international growth	How to facilitate co-operations with national organizations and global partners?
Fundraising for SBI		How to find the right sustainability-oriented financing sources for high risk SBI-projects?	How to focus sustainability investments?
Customer pull			Lack of sustainability consumer organizations
Incentives		How to create and visualize win-win-win situations?	How to develop concrete benefit schemes to end-users?
Regulation and standards	Slow-paced political decision-making for energy efficiency standards	Lack of a common understanding on sustainability, innovation and environmental standards	Lack of sustainability lobbing inside the industry

Roughly speaking, all groups of interviewees found mostly similar challenges, especially in terms of value networks and team building. However, project business orientation in REC industry and challenges related to fundraising for SBI were present mainly in SBI companies. In addition, in contrary to VC investors, the SBI companies did not perceive pending regulatory decision as such a severe challenge to SBI as investors. Instead the companies highlighted lack of common understanding of sustainability and use of standards as a regulatory challenge. Moreover, while VC investors consider long-time to market and sunk costs related SBI as primary issues in the area of R&D management, the SBI companies felt that it is first and foremost a question of better tools and processes for innovation management.

From policy-maker point of view, the dilemmas of lack of customer pull in REC industry was highlighted in interviews. Interestingly, the academic group of interviewees were more aware of potential solutions for SBI challenges than the companies and investors. However, any of the interview groups could present potential solutions to lobbing, incentives, local invests versus national benefit and marginal competition inside the market. Therefore, these identified challenges might present the most significant SBI barriers in REC industry.

5. Discussion and conclusion

The study was set to investigate what the challenges of sustainability business innovations are in REC industry in Europe and what potential SBI solutions can tackle these problems. First, a thematic framework for SBIs in REC industry was utilized to identify relevant themes, then several professionals from public and private venture financing organizations, REC industry companies, and research organizations were interviewed to increase the understanding of challenges specific for SBI in REC industry. Finally, we analysed the challenges from VC investor, innovation company, policymaker perspectives by interviewing several SBI experts.

The results of the paper suggest that SBIs in REC have several industry specific challenges. The key challenges identified by all of the interviewees were the complex REC industry value network, team building challenges, high R&D-intensity and commercialization management. In addition, the findings suggest that SBIs in REC industry are constrained by project business nature of REC industry, fundraising and internationalization issues, lack of regulation, multitude of standards, lack of customer pull, and intelligent incentives.

It would seem that the challenges in sustainability innovation in REC industry differ from general innovation theories – especially in terms of the importance of complex value networks, project business nature of REC industry and regulation intensity. Moreover, unique challenges of SBI policiec such as, lack of informative sustainability lobbing, local investments and marginal competition were identified.

Several potential solutions for SBIs in REC were identified in interviews. Fundamentally, new tools for SBI screening, evaluation and management are needed to enable companies, VC investors and policy makers to succeed in SBIs. Moreover, REC industry should develop customer-oriented and fast innovation processes that holistically integrate the value networks. Furthermore, creation of national round table decision-making concepts and development of intelligent SBI platforms and tools for cities are critical to develop policy decision-making activities.

When generalizing based on the results, this study has some important limitations. Since the data collected through interviews for the study is limited in number, the implications made should be considered as suggestive only.   However, this paper sets forth several leads for future research. It would be highly interesting to study further the role of VC and policy decision maker in creating SBIs in built environment. Moreover, potential solutions identified in the study should be evaluated and diffused.

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