Session 3.6: Innovations Driving for Greener Policies and Standards – Practices Review

Leap Forward or Snail Speed? Examining Radical Sustainable Innovation

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ABSTRACT

Sustainable building appear to progress rapidly these years. The new technological possibilities could be interpreted as radical, but the objective of this paper is to critically examine, whether some parts of sustainable building technology can be understood as radical or whether we rather witness a continued slow and emergent development. The framework of understanding includes concepts of radical innovation, inventions and sustainability. Radical sustainable innovation (RSI) should break away from the customary and be characterized by high degrees of newness in the entire life cycle. RSI should offer significant enhancements of known benefits, entirely new benefits, or substantial cost reductions, leading to the transformation of existing markets, the creation of entirely new possibilities for sustainable balanced growth and RSI should contribute to a sustainable globe. Serious limitations are addressed. For example buildings are large complex products realised through complex processes and with a considerable lifecycle. It appears impossible that an entire building should/could be radically new. the certification standards represent a possible low denominator for measuring radicality, as criteria for newness related to inventions are found not to be instrumental. Methodologically a selection of international cases of office buildings with very high scores of BREEAM, LEED and DGNB are examined. "Protected economy" cases are sorted away in line with the developed criteria for radical innovation. The result shows that a portfolio of office buildings have reached substantially higher level of sustainability than contemporary building regulations (such as those in EU). There is indeed a gap between a few, substantially more sustainable buildings and the majority of buildings, indicating some radicality, yet not identified as radical innovation here.

Keywords: radical innovation, sustainability, office buildings

1. INTRODUCTION

The current global development of, not only new products, components and renewable technologies for sustainable buildings, but also methods, approaches and tools to support design, production and operation of sustainable buildings are quite breathtaking for anyone trying to establish an overview and take sensible choices. The opportunities are accelerating and are multifaceted. Yet clients and their suppliers largely continue to do business as usual, building and renovating mostly to comply with merely legal requirements. The unrealized potential creates a possibility to take a quantum leap in of sustainability by transcending existing norms beyond legal requirements such as Building Research Establishment Environmental Assessment Method (BREEAM 2016), Leadership in Energy and Environmental Design (LEED 2016), Cradle to Cradle, Deutche Gesellschaft für Nachhaltiges Bauen, (DGNB 2016) and other present day certifications. And to do this on a business basis. There is in other word room for something else than the usual stepwise incremental innovation often seen in buildings. This opportunity coincide with an increasing renewed interest in radical innovation in other industries (Hartman 2005, O'Connor et al. 2008). Radical innovation scholars have developed quite extensive and explicit models for managing such innovations within large companies. These scholars would define radical Innovation as innovation that break away from the customary and are characterized by high degrees of newness (Christensen 1997 Hartmann 2015, Leifer et al 2000). Radical innovations offer significant enhancements of known or entirely new benefits, or substantial cost reductions, leading to the transformation of existing markets or the creation of entirely new possibilities for growth. It is worth noting that radical innovation, as innovation in more general, is firmly embedded in a market and business economy thinking.

On this background this paper ask whether some parts of sustainable building technology can be understood as radical? It conceptualize what radical sustainable innovation is and develop an explorative method for measuring it. And as counterquestion it problematized whether we rather witness a continued slow and emergent development.

Also the bodies developing and operating certifications has sensed the development and has speeded up their continual renewal of the measures of sustainable performance. Here we focus on Building Research Establishment Environmental Assessment Method (BREEAM, BREEAM 2016). BREEAM is a sustainability assessment method for masterplanning projects, infrastructure and buildings. It addresses a number of lifecycle stages such as "new construction", "refurbishment" and "in-use" (BREEAM 2016). Globally there are more than 550,000 BREEAM certified buildings, and more than 2,250,000 buildings registered for assessment since 1990 (BREEAM 2016). Why selecting office buildings? When interested in innovation and radical innovation the focus is not on what is technically possible per se, as in buildings realized on university campuses or other experimental contexts to test future techniques. Rather innovation is embedded also in markets and economical feasibility. Our original position was that office buildings are tested by the market, paid by private companies. Moreover many radical ideas in buildings have over the years been realized by fiery souls using their private houses as testbed. Through loads of entrepreneurial effort by the designer, owner and constructor in one realize radically new villa concepts. However such projects often never got beyond that. What surface when looking at office buildings is the marketing and publicity effect of certain enterprises operating in and from a sustainable building. The category include utility company, building component manufacturer, building service suppliers etc. One might cynically observe, that they merely want to show off. We have chosen to include those here as after all even these companies operate in our present markets.

The paper is structured in a traditional manner. It commence by developing the theoretical understanding and continue to posit the methods that can answer to the objectives of the research. The follows case descriptions of our found candidates for radical innovations. The paper analyse these and finalise the argument through a discussion and a conclusion.

2. FRAMEWORK OF UNDERSTANDING

The framework commence by the concept of innovation, moving on to radical innovation. Sustainability is then introduced and inserted into our tentative definition of radical sustainable innovation.The Oslo Manual (OECD 2005) defines innovation as follows: "An innovation is 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". This definition distinguishes in a linear manner between invention and innovation, believing that invention are globally new and not necessarily implemented in a practice, whereas innovation is only counted as such if the change is implemented. This implies that radical innovation at a time needs to be almost as new as inventions yet is required to have experienced implementation. Also innovation is normally measured up against its context, i.e. innovation is new in relation to a specific contextual and not necessarily globally new. We suggest to depart from this contextual criteria for innovation below. Radical Innovations break away from the customary and are characterized by high degrees of newness. Radical innovations offer significant enhancements of known benefits, entirely new benefits, or substantial cost reductions, leading to the transformation of existing markets or the creation of entirely new possibilities for growth. These innovations are also referred to as "breakthrough", "discontinuous", or "paradigm-shifting" (Christensen 1997 Hartmann 2015, Leifer et al 2000). It is important to note that disruptive innovation is different from radical. Disruptiveness may occur from wellknown elements of innovation reshuffled. Disruptive innovation can be defines as "a process were a smaller company with fewer resources is able to successfully challenge established incumbent businesses" (Christensen et al 2015). Disruptive innovation originate in the low-end of new-market footholds and only compete with mainstream when quality catch up to their standard (Christensen et al 2015). We adopt the position that innovations within sustainability should comply with certain special rules. Where innovation concepts are embedded in market economy concepts, sustainable innovation needs to depart from this unambiguous embeddedness and rather refer to a sustainable economy. Sustainability was originally defined as "development that meet the needs of the present without compromising the ability of the future generations to meet their own needs" (Brundtland 1987).The notion of sustainability has undergone signification development even if still ambigious. As many other societal goals it is a moving target, and should be. This goes for the content and weight of the original Brundtland dimension of environmental, social and economic sustainability (Chathara et al 2015). On this background a tentative definition of radical sustainable innovation:

- RSI Break away from the customary and are characterized by high degrees of newness. In the entire life cycle and in all elements, financial, process, product, client relations, organisation management

- RSI offer significant enhancements of known benefits, entirely new benefits, or substantial cost reductions, leading to the transformation of existing markets or domains or the creation of entirely new possibilities for growth and sustainable balances encompassing at least an environmental, social and economic aspect
- RSI contributes to a sustainable globe

We suggest that within radical sustainable innovation in office buildings a global convergence has meant that it makes sense to move from a contextual definition to a worldwide covering definition, which resembles the demands of patented inventions, whose novelty is tested in a broader region like Europe or US. In fact we suggest that radical sustainable innovation should be measured by a global novelty criteria.

3. METHOD

We draw on innovation and radical innovation literature to conceptualise these parts and combine these with sustainability. This approach is chosed because of a paucity of contributions conceptualizing radical sustainable innovation. In an initial phase radical examples were sought for outside the certified portfolio. This approach however quickly was abandoned because we did not have resources to follow up on promising, yet poorly documented cases. Compared to these potential radical cases, the certified were far better documents. On this basis we then use sustainable building certification schemes. The literature comparing certification schemes within sustainable building, show large similarities between tools (Chathana et al 2016). The emphasis are on environmental sustainability (roughly 70% of the criteria points), and less on social sustainability (roughly 25 % of the criteria points), and very little emphasis is assigned to economic sustainability (Chathana et al 2016). Several consecutive searches have been made in BREEAM, LEED, DGNB and Cradle to Cradle certification databases from 2012-2016. Case studies of remarkably sustainable building has been collected over this time period. Cradle to Cradle certification is however only covering building components as is therefore a supplement. LEED platinum buildings were examined on an exemplary basis. According to LEED there are 852 certified platinum buildings (LEED 2016), however based on the exemplary evaluation they appeared less performative than the BREEAM "outstanding" certification which was therefore selected.

BREEAM is an entire suite of certifications targeted different phases of a building's life and different sectors of buildings (domestic, offices, public institutions etc, BREEAM 2016). There are certifications for four different phase/stages: Master planning, new construction (incl. design), refurbishment, in-use. They include up to ten aspects related to energy and water use, the internal environment (health and well-being), pollution, transport (access to public transport and bicycle facilities), materials, waste, ecology (including biodiversity), management processes and innovation. In total there are typically 80 evaluation points. The criteria dimension are typically the following: Management, health and wellbeing, energy, transport, water, material and waste, landuse and ecology, pollution and innovation. The scores at these evaluation points are summed up in a score card, with a score from 1 to 100%. The scores are translated into stepwise categories: "Passed", "Good", "Very Good", "Excellent", "Outstanding". Outstanding means scoring more than 85 points out of 100 and around 1% of all ratings do that (BREEAM 2016). For example in the BREEAM 2014, the energy dimension Excellent is 37-52,5% reduction of energy consumption compared to national building regulation and Outstanding is 60-82,5% reduction (BREEAM 2014b). Although BREEAM is increasingly international, it is 96.4% of its certifications of non domestic buildings (including offices), that are placed in the United Kingdom. The figure for 2012 was 92.5% showing the gradual grow in internationalization (BREEAM 2014). Using our latest searches in the greenbook data base we were in april 2016 able to identify 256 cases of BREEAM certified buildings in class "outstanding". This figure had grown to 281 in october 2016. Out of these 76 were categorized as office building, but our search also covered mix-use buildings. The certification were according to BREAAM 2009 or 2011. None referred to BREEAM 2014 which is presently a draft (BREEAM 2014). In the further selection the more recent and highest scores (meaning more than 90%) were selected, and thus deselecting even relative high scores. Also some examples of "protected economy" cases, such as experimental buildings on university campuses were sorted away in line with the developed criteria for radical innovation. We ended up with a sample of five building which are described below.

There are several limitations to our approach. Our analysis here rely on preliminary comparisons between the certifications and exploratory searches. As for patented sustainable products and processes, although preliminary searches were made into patented sustainable building components, it has not been established whether the patented products constitute a more radical innovation than cradle to cradle certified products. Our preliminary

position is that the patent approval process do not evaluate the products as systematics as a cradle to cradle certification would. It is merely newness that are the central criteria.

4. CASES

Below the five cases found with the highest score is presented.

The Air Street building is placed in central London UK and part of a larger project carried out by Crown Estate. The building was certified after BREEAM 2011 New Construction, Office and scored 94,16 % after finalizing in autumn 2015. An earlier interim certification was rated slightly lower. The project is a combination of preservation of an existing listed building, and demolishing and new built of the two upper floors aiming at delivering office facilities.The stronger part of the evaluation were energy, waste, materials and management. The weaker health, transport, water and innovation. On energy for example the building scored 25 credits out of 27 due to the low carbon energy strategy adopted, provision of monitoring facilities, use of district heating, LED lightning and solar panels. Also the wall insulation used reduces heat loss by 65%.

The Bentley Works, Doncaster UK building was rated outstanding with a score of 92,5 % in BREEAM interim in 2015. The owner, SKANSKA UK, a contractor, also used the company's internal "Color Palette" certification tool. The Colour Pallette tools is organized in economic, green and social dimensions. Skanska describe the economic scores like this; a total green payback period of 11 years and creation of 70 new full-time positions. The green scores points are the following: Net zero primary energy site, office building uses 67% less energy than UK building regulations, 11% reduction in embodied carbon, zero construction waste materials to landfill, zero hazardous materials, net zero potable water & 70% less water than BREEAM benchmark. In the social dimension SKANSKA highlights a healthy indoor and outdoor environments for building occupants and workers. In other words it derives that the building substantially surpass BREEAM outstanding criteria in one dimension, water use, yet operate a very limited social sustainability perspective.

Le Hive, Ile de France, Paris, is Schneider Electric's headquarters in France. Schneider is a large global electricity installations supplier. The building scored 93,8% in the BREEAM In-Use certification in 2013. The building complex is at 35.000 m2 and energy consumption level at 78 kwh/m2 per year was achieved from the double level of 150 kwh/m2 per year. The BREEAM In-Use rating included Asset performance 'Excellent', 75%; Building management performance 'Outstanding', 88%; Occupier management performance 'Outstanding,' 92%. The energy use for Heating Ventilation and Air Conditioning (HVAC) and lighting have been halved over three years through active energy efficiency, without changing the structure of the building and without energy production, according to Schneider. Other dimensions of sustainability include recycling and sorting of 12 kinds of waste (0% to landfill), efficient management of water – rain sensors, real time leak detection, health and well-being services on site, consultation with occupiers, acoustic comfort improvement, innovative comfort measurement. Greenhouse gas emissions study, use of 100% eco-labelled products for cleaning. Closely managed energy consumption and centralised control and monitoring using innovative tools. Conservation of green outdoor areas, improvement of bio-diversity, establishment of beehives on site. Thus the Hive stays within the BREEAM outstanding category.

The Angel Square building in Manchester, is the headquarters of the Co-operative Group. The building provides office facilities for 3,000 employees. The Co-operative Group is owned by 8 million members. The building scored 95,16%, outstanding, in the BREEAM (2008) offices certification in 2013. Some of the dimension highlighted were: The building is powered by a pure plant oil fed Combined Heat and Power (CHP) system and utilizes rapeseed oil which is grown on the Co-operative's own farm land. Surplis energy is sent back to the grid. Other features include LED lighting and a system to recycle waste and rain water. Apart from its unusual architectural qualities, the building's sustainable solution do appear to go beyond BREEAM certification at the CHP system and the recycling of water.

The 50 person large new office building for the Dutch company Geelen Counterflow, that manufacture industrial coolers and driers, obtained two BREEAM certifications at the level Outstanding in autumn 2015. "Design" at 94.19% and "Post construction" at 99.94% (Greenbook 2016). The building's structure is prefabricated walls and floors of 100% unglued and non-chemically treated wood, grown in sustainably managed forests in Germany. Where possible "Cradle To Cradle" certified building materials will be applied. The garden includes a variety of local plants, flowers and nesting sites for birds, bugs, bats and amphibians. By building according to the "Passive

House" guidelines and powered with 330 solar panels on the roof, the office will produce 50% more renewable energy than the total energy consumption for heating/cooling, ventilation, lighting and accessories. The extra energy will power machinery in the company's factory. Adjustable daylight infiltration, air quality, and indoor lighting, imply that the office contribute to a healthy work environment and employee productivity according to the owner Geelen Counterflow. Some materials used: The basement made by “ecocrete” concrete and also (partly) prefabricated via a hollow-wall system made of 100% recycled granules. Building structure (beams, pillars) supplied by NurHolz. Facade Accoya wooden battens (cradle to cradle certified). Window frames Accoya. Glass AGC (cradle to cradle goal and transport minimizing). Paint Drywood woodstain semi-transparant water based lack. Roof Derbipure vegetal (cradle to cradle certified). Insulation Roof Kingspan Unidek EPS. Insulation cellar DOW XPS (cradle to cradle certified). More sustainable than mentioned here is included. Through producing more 50% energy that it consumes and adopting the policy of adopting “as many as possible” cradle to cradle certified building material, the building clearly transcend the BREEAM outstanding certification, apart from scoring almost 100%. Nevertheless some elements in the building appear to be of more traditional kind, such as the electricity cabling and the cloak system. There is no mention of any social sustainability dimensions apart from what is incorporated in the BREEAM certification.

5. DISCUSSION

The intention is scrutinize the concept of RSI through these cases of outstanding performance. It is therefore important to discuss where the cases surpasses the scale of BREEAM or not. As we have suggested that RSI should surpass the certification standards of sustainable buildings. In general the cases scored high, yet they did not surpass the scale. There are few exceptions: Bentley works surpassed the BREEAM outstanding certification in one dimension, water use. The Angel square building features a CHP system feed by rapeseed oil and recycling of water. The Geelen Counter flow case has a number of cradle to cradle certified building components inbuilt, yet still misses others. The cases mention little about social sustainability. The actual measures in the outstanding cases rarely relate to “outside” building stakeholders and focus one’s own employees. In this dimension we thus find no elements addressing a broader understanding of what social sustainability is defined as (Colantinio and Dixon 2010). It does appear that the certified companies go “hunting points” inside the certification rather than pursuing a comprehensive sustainability agenda (Chathera et al 2016). As mentioned we found 852 LEED certified platinum buildings (LEED 2016) and 281 BREEAM outstanding in 2016. Out of the BREEAM 76 were categorized as office building, but our search also covered mix-use buildings. These numbers does raise an issue whether sustainable buildings that perform just above these many certified building can be understood as radical sustainable innovations? As our concepts requires a substantially improved product or process, the distance to this portfolio of very well performing sustainable building does appear marginal and thereby in contradiction to being radically different. Yet the distance to the majority of building regulation compliant buildings at snail speed are still substantial. The outstanding certified building is thereby a rare exception.

6. CONCLUSION

This paper set out to critically examine, whether some parts of sustainable building technology can be understood as radical or whether we rather witness a continued slow and emergent development. We conceptualise radical sustainable innovation, RSI, as innovation that break away from the customary and characterize RSI by high degrees of newness. In the entire life cycle and in all elements, financial, process, product, client relations, organisation and management. We posited that RSI offer significant enhancements of known benefits, entirely new benefits, or substantial cost reductions, leading to the transformation of existing markets or domains or the creation of entirely new possibilities for growth and sustainable balances encompassing at least an environmental, social and economic aspect and that RSI contributes to a sustainable globe. Methodologically a selection of international cases of office buildings with very high scores of BREEAM, LEED and DGNB were examined. Even if certified “outstanding”, “platinum”, some buildings with lower performance (including some slightly older), and “protected economy” cases were sorted away in line with the developed criteria for radical innovation. The result shows that a portfolio of office buildings have reached substantially higher level of sustainability than contemporary building regulations. There is indeed a gap between a few, substantially more sustainable buildings and the majority of buildings, indicating some radicality, yet it is not identified as radical innovation. Buildings are complex products and the certification schemes are useful as measurement of this complexity and the certifications given also demonstrate that the buildings studied do arrive at some radical elements, yet still possess a number of more

traditional elements. Future research will include a more systematic comparison of certification systems and highest rated buildings.

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