Refurbishment certification schemes: aspects of productivity and sustainability

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Abstract: *Sustainability rating tools can be analysed in a productivity perspective. Government regulations, including taxes and fees that make firms internalize negative environmental externalities, reduce the gap between sustainability and productivity. Productivity measurement methods for new construction are difficult to apply to refurbishment projects, and there is no consensus on measuring the sustainability of refurbishment processes. The purpose here is to investigate how sustainability concepts in building certification schemes for refurbishment are related to productivity, using BREEAM Refurbishment Domestic Buildings and LEED for New Construction and Major Renovations as examples. A set of criteria for analysis is developed here. While this BREEAM scheme has its focus specifically on refurbishment, the LEED version has less that is specific to refurbishment processes. These schemes mainly focus on post-refurbishment assessment. Long-term productivity is related to economic sustainability, and recent refurbishment versions of certification schemes in Germany and Japan recognize more than environmental sustainability.*

Building certification schemes, productivity, sustainability, refurbishment

Introduction

In general, the successive development of stricter government regulations intended to secure environmental sustainability, including taxes and fees, is expected to reduce the gap between sustainability and productivity on the level of firms. Furthermore, the diffusion of sustainability rating tools influence market prices of goods and services. Apart from the construction industry, studies from other fields show how negative environmental externalities are internalized by firms, which realize immediate or delayed effects on their productivity [1-3]. The relation between sustainability and economic growth is a major policy issue in most countries, and this is reflected by policies for raising sustainability and productivity at a firm and project level in the construction industry.

While there are well-established productivity measurement methods for new construction [4], refurbishment projects are different, primarily because they share quality measurement problems that are commonly found within the service sector [5]. There is a complicated relation between sustainability rating tools and property valuation use [6], which is interesting for understanding the mechanisms of how ratings affect market prices, which in their turn form the basis for productivity estimates. Another linkage where there is a greater lack of knowledge is how ratings interact with internal company systems for environmental management, aligned with ISO 14 000 standards or otherwise, which focus on processes more than products. The aim of this paper is to investigate how sustainability concepts in building certification schemes for refurbishment are related to productivity, using BREEAM and LEED as examples.

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Earlier studies provide information on limitations of sustainability and environmental assessment tools. Berardi [7] notes that sustainability rating systems tend to ignore economic aspects and focus mainly on the environment. Energy performance is highlighted in these schemes as the most important criterion for assessing building sustainability although the predicted energy performance of certified buildings falls below what is defined as optimal levels in the schemes. Also, environmental assessment tools have shifted from objective evaluation of resource use, ecological loadings and indoor environmental quality, to assessing market transformation [8]. Ding [9] identifies eight categories where current environmental assessment tools present limitations: usability as a design guideline, usability for selecting optimum project options, financial aspects, recognizing regional variations, complexity (input), evaluation of qualitative and quantitative data, weighting and measurement scales. In addition, use of a single criterion, such as economic efficiency or energy efficiency, for decision making, has been criticized. Instead, a sustainability index or a multi criteria approach has been proposed for environmental assessment.

Obviously, environmental assessment tools can be used for different purposes, in different phases of building and refurbishment projects, and by different actors. Kaatz et al. [10] propose that instead of using sustainability assessment methods solely to evaluate building performance, they should be integrated in earlier phases of the project, particularly during decision-making, allowing sustainable development principles to be incorporated in building projects. In a recent study, Schweber and Haroglu [11] draw an interesting relation between level of commitment to sustainability and use of the Building Research Establishment Environmental Assessment Methodology (BREEAM). Professionals committed to sustainability use BREEAM in their design decisions, but others apply it only to assessment. In an analysis of the effects of BREEAM on construction professionals and clients, Schweber [12] notes that, for the project team, it serves as a communication tool and sets discrete technical standards for their design decisions, and for clients, provides the opportunity to demonstrate commitment to the sustainability, which enhances the client's reputation and provides a framework that gives the client a sense of being in control.

As is well known, some environmental assessment tools are in international use. Cole and Valdebenito [13] analyse the importation of BREEAM and LEED (Leadership in Energy and Environmental Design) in six countries, including Sweden, and note that certain countries, such as Australia and Japan, apply domestic standards.

Linking productivity to sustainability

Productivity is defined as 'a ratio of volume measure of output to a volume measure of input use' [15, p.11], inputs and outputs valued at market prices. The Brundtland report defined sustainable development anthropocentrically as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' [16, p.54], leaving the question open of it is related to market phenomena. Sustainability has come to be understood as having three dimensions: environmental, economic and social.

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The financial community's understanding of sustainability is understandably often related to economic sustainability. However, linking other sustainability features of buildings and properties to economic performance shifts this community's perspective towards environmental and social aspects [16]. This can be achieved simply by informing financial decision makers of the potential for environmental and social performance to generate cash flow, add value and reduce investment risks [17].

One way to link sustainability to productivity is thus by determining the increase in the market value of property that includes sustainability features. Increased market value of an output improves productivity, ceteris paribus. A study using hedonic regression modelling of data collected in Switzerland identifies a relationship between the environmental performance of residential buildings and their rental levels. Among the 36 sustainability indicators, water efficiency, health and comfort, and building safety and security, are shown to have significant positive price effects [18]. Also, sustainable building features, such as energy efficiency, lead to lower operating and maintenance costs [17].

A barrier to linking the sustainability of properties to economic performance is data availability [17]. Several studies consider these barriers as linked to environmental assessment tools. Firstly, sustainable building labelling is not fully compatible with the tools and methods used by the financial community for risk analysis and property rating [16]. Secondly, it is difficult to reflect a sustainability performance score from a sustainable assessment tool in a valuation because traditional methods of valuation may cover the same building features, resulting in double-counting. Therefore, whether to treat sustainability features as an additional bonus or integrate them in the traditional valuation methods is an issue [6]. Thirdly, there are numerous sustainability assessment tools. Lützkendorf and Lorenz [19] discuss aspects of the development of sustainability assessment tools, including standardization or not, complex or simple tools, mandatory and voluntary tools, and applicability for risk analysis and property evaluation.

The effects of regulation on the gap between environmental sustainability and productivity is analysed in a number of studies from other sectors of the economy. Majumdar and Marcus [1] provide two opposing views. Economists claim that high levels of environmental spending can lead to a decline in productivity, while business strategists maintain that well-designed environmental rules and regulations would increase firm competitiveness and enhance productivity. Their study is based on electricity utilities and compares the effect on productivity of two types of regulation that either restrict choice or provide flexibility. They conclude that flexible regulations increase productivity while also encouraging entrepeneurship, creativity, risk taking and internalization. Asche et al. [2] in their study of salmon farms note the positive relation between environmental regulation and productivity. Compared to other industries, environmental effects are internalized in salmon farming decision-making since the negative environmental externalities have immediate or delayed negative effects on the farm's production. Telle and Larsson [3] note that studies claiming negative relations between environmental regulations and productivity are based on industry

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level data. Based on plant level data instead, traditional methods of determining productivity growth are found to be problematic.

Productivity in refurbishment

Refurbishment is not pure production of goods; therefore physical measures of productivity such as [concrete laid]/m^3, typical of new construction are insufficient. Refurbishment productivity should take into account building user productivity.

For office refurbishment projects, Feige et al. [20] provide insights into employee productivity. Although they do not identify a direct relation between sustainability and productivity, they note that higher levels of comfort result in improved employee productivity. Also, a comfortable working environment reduces employee turnover and makes the company more attractive to potential employees. In a study of office conversions, Holm and Bröchner [21] analyse the effects of employee-craftsmen interactions. They highlight the local negative effects of refurbishment processes, namely dust and noise, which disrupt office work and further decrease employee satisfaction, influencing their productivity. Customer satisfaction surveys can be used as output indicators of these effects.

In housing refurbishment, buildings might be occupied by tenants during the process, which has consequences for labour productivity. The willingness of tenants to collaborate is important; issues such as limited storage space and space for collecting waste can be particularly challenging in refurbishment schemes and have negative impacts on process productivity. Client contributions are an important input, particularly in refurbishment projects where owners are heavily involved, something which also affects productivity. Furthermore, uncertainties associated with existing structures, out-of-date and inaccurate drawings, and discovery of hazardous substances can require changes to refurbishment project plans and negatively affect productivity [22].

Methodology

The empirical part of this paper is the analysis of two building assessment tools for a range of building types: BREEAM Refurbishment Domestic Buildings and LEED for New Construction and Major Renovations. These tools were chosen because both cover at least some aspects of refurbishment. For each criterion derived from earlier literature, schemes have been searched to see whether there is a category related to refurbishment productivity. For each criterion several keywords have been developed (see Table 1), used for searches in both schemes and then relevant passages have been read.

ISBN: 978-84-697-1815-5

Table 1. Keywords used for each criterion

Criterion	Keywords
Efforts to inform tenants about the costs and benefits of sustainable refurbishment	Users, occupants, tenants
Aims at goal-setting and internalization rather than forcing strict solutions	(not applicable)
Negative effects of local disruptions to client's employee productivity	Office, employee, satisfaction, productivity
Effects of tenant-labour interactions on refurbishment process productivity	Occupants, tenants, workers, operatives
Effects of space limitations (material storage, waste separation) on process productivity	Storage, material storage, space
Client role in process productivity	Client, productivity, owner, developer
Effects of unexpected situations (e.g. discovery of hazardous substances) on process productivity	Unexpected, hazardous, structural, drawings
Effects of sustainable features on employee productivity	Occupants, productivity, employee
Economic effects of sustainable features	Cost, benefit, economic
Compatibility with financial community's internal methods (risk analysis and property rating)	Compatibility, compatible, financial, property, valuation, risk analysis

Analysis

The two schemes are analysed here according to the ten criteria of Table 1.

Efforts to inform tenants about the costs and benefits of sustainable refurbishment

One of the objectives of BREEAM is to increase awareness among stakeholders of the benefits of environmental buildings. The tool's management category includes a home users guide; however, this information is related more to how users can benefit from the refurbished building. It does not provide a cost-benefit analysis for tenants. Several categories of LEED relate to building occupants; however, LEED is not process oriented and apparently does not require that tenants receive cost-benefit information.

Aims at goal-setting and internalization rather than forcing strict solutions

BREEAM includes detailed assessment criteria, procedure, compliance notes and schedules of evidence for each category. These provide a detailed guide to how the assessment should be carried out. However, no particular technology is prescribed to achieve these goals. LEED explains the requirements as well as the potential technologies and strategies related to each category. Compared to BREEAM, LEED provides more suggestions about environmental solutions but its explanations are not binding and serve only as recommendations.

ISBN: 978-84-697-1815-5

Negative effects of local disruptions to client's employee productivity
The criterion is not applicable to the analysed tools. BREEAM aims to assess only domestic buildings, while the LEED tool does not cover the refurbishment process effects, although it concerns office renovation.

Efforts of tenant-labour interactions on refurbishment process productivity
Neither tool covers potential decline in productivity due to tenant-labour interactions. BREEAM clearly pays attention to the management and more particularly project management such as requiring project meetings. However, there is no requirement for tenants to be included in these meetings. LEED does not require information on the refurbishment process, and thus does not take account of tenant-labour interactions during the refurbishment process.

Effects of space limitations (material storage, waste separation) on process productivity
The BREEAM tool provides clear recommendations for compliance in cases of limited site space for segregation and storage of waste. However, it does not include impacts on productivity and the difficulties related to materials storage space. LEED provides information about need for space to store waste, but only in the post-refurbishment phase and in relation to occupants' waste. LEED provides no information about how refurbishment site waste should be handled.

Client's role in process productivity
The client is mentioned frequently in the BREEAM tool; however, the client's role is mainly limited to service consumers. The tool acknowledges the importance of key design team meetings where both contractors and clients participate. Responsibilities are assigned to developers (clients) in both the design and post-refurbishment phases. However, the client's role timely decision making - particularly in relation to unexpected changes during refurbishment – which is valuable, is not included in the tool. LEED assigns responsibilities to owners (clients), mostly focused on appointing qualified individuals to facilitate the assessment process. It provides recommendations to owners to make their environmental choices, linked to achievement of financial savings.

Effects of unexpected situations (e.g. discovery of hazardous substances) on process productivity
Uncertainties associated with the existing building are not considered in the BREEAM tool. Use of less hazardous materials and ways to deal with non-hazardous materials in the refurbishment process and demolition are mentioned in BREEAM, but discovery of hazardous substances and the potential influence on productivity are not acknowledged. Other unexpected situations that may occur during refurbishment, such as the need for structural changes, are not covered by BREEAM. In dealing with the comfort of occupants and building reuse, the LEED tool acknowledges the importance of minimizing exposure to hazardous gases and chemicals, and removal of hazardous substances. However, it provides no information on other unexpected situations that may occur. The LEED tool links the existence

ISBN: 978-84-697-1815-5

of hazardous substances to the comfort of occupants, but omits any effects on refurbishment process productivity.

Effects of sustainable features on employee productivity
The criterion of employee productivity is irrelevant for the BREEAM tool since it only assesses domestic refurbishment. However, it includes tenants' comfort and wellbeing, although it does not link these aspects to productivity. Several categories of the LEED tool refer to the intention of improving occupant productivity, such as maintenance of a comfortable air temperature. The tool does not directly refer to employees, but it does mention that it can be used for office refurbishment and thus refers to occupants more generally.

Economic effects of sustainable features
Reduction of costs and low cost sustainable solutions are stated as objectives in the BREEAM tool, although only in the category of energy are energy savings linked to costs. The tool does not demand a cost-benefit analysis for sustainable actions taken during the refurbishment process. In the LEED tool, maximizing environmental and economic performance is given as one of the objectives. However, and similar to the BREEAM tool, costs and benefits are only mentioned in the energy and athmosphere category, where lower operating costs are acknowledged.

Compatibility with financial community's internal methods (risk analysis and property rating)
The internal methods of the financial community or the property industry as concerns property valuation after refurbishment are not covered in either the BREEAM or the LEED tool.

Conclusions
To conclude, it is obvious that sustainability rating tools can be analysed in a productivity perspective. The purpose here has been to investigate how sustainability concepts in building certification schemes for refurbishment are related to productivity, using BREEAM Refurbishment Domestic Buildings and LEED for New Construction and Major Renovations as examples.

Ten criteria were derived to analyse BREEAM and LEED. A fundamental observation is that building users are important stakeholders in refurbishment projects, both influencing and being influenced by a project. Particularly, in office refurbishment, employee productivity might be reduced by local, negative effects of an ongoing project. Process productivity during refurbishment is subject to space limitations, client inputs and additional activities and resource use due to unexpected discoveries.

The analysis shows that both tools focus mainly on the post-refurbishment assessment, although some aspects of design phase are covered by both tools, and the process itself is partly included by BREEAM, particularly in its management category. Productivity translated into costs and benefits is only acknowledged in the energy categories of these tools, and they

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do not reflect the process of refurbishment. This understates the sustainability effects of disruptions on process productivity due to tenants' involvement and space limitations, effects of clients' decisions during the process and disruptions due to unexpected situations. More recent advances in the development of sustainable rating schemes show that there is both a need and a potential for more comprehensive assessment, catching aspects of productivity and adopting a wider sustainability definition covering all three dimensions. Recent refurbishment versions of certification schemes in Germany and Japan recognize more than environmental sustainability.

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