A Sustainability Performance Assessment Tool for SMEs

G. Fischl[1] and T. Olofsson[2]

[1]*Umea School of Architecture, University of Umea*
[2]*Applied Physics and Electronics, University of Umea*

Abstract
Small- and medium-sized enterprises (SMEs) within the construction and design domain are already been provided with several sustainability assessment techniques. This paper presents an easy to use assessment technique for 20 building projects in terms of a sustainability performance assessment tool. Originally, this assessment tool was conceived within the NEES project supported by the Nordic Periphery Programme.

Introduction

The aim of this paper is to propose an easy to use sustainable building performance assessment technique within the framework of NEES project that can be used to compare sustainability performances of SMEs, particularly in architectural firms. The NEES project is supported by the Nordic Periphery Program and aims to investigate products and services that is in accordance with its natural (N), energy efficient (EE) and sustainable(S) perspective.

Over the years, it has become obvious that sustainable design imposes new demands on architects and planners to broaden their expertise to embrace environmental engineering, ecological ways of constructions, efficient infrastructure, and unique urban development projects (SAR, 2010). Furthermore, it is also clear that characteristics like how a building's spatial hierarchy is organized, or day lighting, or design affects on indoor climate and energy performances are all important architectural considerations. The building method, materials and construction technology predestinate the carbon footprint of the building and its life cycle. The use of urban space is concerned with the land efficiency; therefore balance between the area of agricultural claims, local climate and livable space minimum is essential. Finally, infrastructure as a whole requires optimization in efficiency and a decrease in waste production.

Professional bodies have realized that sustainable development has implications for the wider relationship between professionals and society. This is particularly the case for the built environment professions, where buildings have a major impact in environmental, economic and social terms (United Nations Environment Programme, 2007). To take one example, buildings are major emitters of carbon, which contributes to global warming: for example, if all the energy used in constructing, occupying and operating buildings is combined then buildings are responsible for 50 per cent of carbon emissions in the UK (Building Research Establishment, 2003). This is also a broader global issue, with the built environment a major contributor to global environmental issues, and with consequent impacts on the natural environment. There have been done several building performance models that are capable to predict an energy performance of a building. The most well-known are the BREEAM (Building Research Establishment's Environmental Assessment Method), or the LEED (Leadership in Energy and Environmental Design), as well as the Greenbuilding and Miljöklassad byggnad. The latter, the Swedish system is based on scientific and measurable criteria, this quality is not as established in the other systems.

The Swedish Environmental Protection Agency argues that to combat climate change, national climate policies must be developed in correlation with international climate agreements. According to Pérez-Lombard, Ortiz and Pout (2008), in the developed countries buildings contribute between 20-40% of the total energy consumption and therefore it has exceeded other major sectors such as industry and transportation. In Sweden, the energy consumption of buildings are approximately 40% and it costs about 150-200 billions of crowns annually (IVA, 2012) which indicates an energy.

Much of the work on sustainability can be characterized by three key approaches. The first is concerned with definitions of sustainability – where they have emerged from, what they attempt to achieve and how they can be compared (Baker et al., 1997; Haughton and Hunter, 1994; Rees, 1999). The second approach is more reductive, thus the focus is on establishing what is unsustainable, how to make practices more sustainable and how to evaluate sustainable outcomes. This operates with checklists, indicators, triple bottom-line accounting and ecological footprints (Wackernagel and Rees, 1996). It is based on the premise that we know enough about the planet as well as the people (i.e. Redclift, 1996). The third approach discusses sustainability as a dialogue – a way of defining and controlling the agenda for change and development (i.e. Sandilands, 1996).

A sustainability performance assessment tool (SUPERASSIST) as a questionnaire was developed to assess sustainability performance in SMEs. This tool has potential in screening SMEs sustainability performance particularly in building projects. The assessment tool consists of items according to ISO TC 59, which describes the minimum performance measures necessary for sustainability assessment (Seo, Tucker, Ambrose, Mitchell and Wang, 2005). Under each main factor (Indoor air quality, energy, resources and materials and finally environmental impacts to surrounding) ratings can be given on a four-point Likert-scale (1=Agree, 2=Slightly Agree, 3=Slightly Disagree, and 4=Disagree) on each item. In addition, questions related to sustainable project management can be included according to Clements-Croome's (2013) recommendation. The items representing relevance to sustainability and its combination can contribute to different factor results. Weighing of the items in the factor measure can also be possible, thus a more quantitative result would be achieved. The SUPERASSIST is presented in Table 1.

Table 1. Sustainability performance assessment tool (SUPERASSIST); Scale is from 1=Fully Agree, 2=Slightly Agree, 3=Slightly Disagree to 4=Fully Disagree.

Main factors	**Sub-factors**	**Selected items**	**Scale (1-2-3-4)**
Project management	Shared vision	The project briefing based on a well-defined mission and vision at the early stage	
		The project applied adequately a unity of vision between consultants, contractors, manufacturers and facilities managers.	
	Information flow	The coordination of information across the whole building process was adequate	
		The project applied adequate standardized processes rather than improvisation	
		The project applied adequate interoperability of systems and their interfaces	
		The project applied adequate documentary evidence on integrated processes	
		The project applied adequate proven and tested processes to be adapted and	

		used on other similar projects
	Auditing	The project applied adequate auditing and monitoring processes
Indoor environment	Thermal comfort	Performance of room temperature control is adequate
		Degree of moisture control is adequate
		Vertical distribution of air temperature is adequate
		Air velocity is adequate
	Lighting	Degree of visual access to the exterior & daylight access is adequate
		Performance of access to day lighting is adequate
		Performance of anti-glare measures is adequate
		Illumination levels are adequate
		Degree of lighting controllability is adequate
	Air quality	Degree of sources control is adequate
		Performance of ventilation is adequate
		Performance and quality of operation plan is adequate
	Noise & acoustics	Level of noise is adequate
		Level of sound insulation is adequate
		Level of sound absorption is adequate
Energy	Operational energy	Total primary energy consumption in operation is adequate
	Efficient operation	Performance of monitoring is adequate
		Performance of operational management system including commissioning is adequate
	Thermal load	Building orientation is adequate
		Thermal load of windows is adequate
		Insulation level of exterior wall and roof is adequate
	Natural energy utilization	Degree of direct utilization of natural energy is adequate
		Degree of indirect utilization of natural energy is adequate
	Building systems' efficiency	Performance of HVAC is adequate
		Performance of ventilation system is adequate
		Performance of lighting system is adequate
		Performance of water heating system is adequate
		Performance of elevator system is adequate
Resources and materials	Water consumption	Amount of water consumption is adequate
		Degree of utilization of rainwater and grey water is adequate
	Resource productivity	Degree of use of recycled materials is adequate
		Degree of renewable resources is adequate
		Degree of reuse of existing skeleton is adequate
		Durability of materials is adequate
		Performance of waste disposal is adequate
	Avoidance of pollutant materials	Degree of avoidance of hazardous materials is adequate
		Degree of avoidance of CFCs and halons is adequate
Environmental	Pollution	Performance of run-off management is

impacts to surrounding		adequate
		Degree of acidification is adequate
		Creation of photo-oxidants is adequate
		Degree of nitrification is adequate
		Degree of emissions of water pollutants is adequate
		Degree of emissions of soil pollutants is adequate
	Load on local infrastructure	Load on traffic management systems is adequate
		Load on waste treatment systems is adequate
	Wind damage related issues	Wind damage evasion measures are adequate
	Light pollution related issues	Light pollution evasion measures are adequate
	Heat island effect related issues	Heat island evasion measures are adequate
	Load on local infrastructure related issues	Load on sewage treatment is adequate
		Degree of access to sunlight of adjacent property is adequate
Quality of service	Service ability related issues	Functionality and workability is adequate
		Pleasantness is adequate
		Complexity is adequate
		Originality is adequate
		Flexibility is adequate
		Privacy is adequate
	Durability related issues	Earthquake-resistance is adequate
		Performance of daily maintenance/updating and frequency is adequate
	Flexibility and Adaptability related issues	Space margin is adequate
		Floor load margin is adequate
		Adaptability to various requirements is adequate
Outdoor environment	Ecosystem related issues	This project has an impact on biodiversity
		This project has an impact on cultural diversity
	Townscape and landscape related issues	Accessibility is adequate
		Urban planning issues are solved adequately
		Landscaping issues are solved adequately
	Local characteristics and culture related issues	Sustainability features are adequate
		Usability issues are addressed
		Supports cultural activities

Note: Scale consists of 1=Fully Agree, 2=Slightly Agree, 3=Slightly Disagree and 4=Fully Disagree.

One of the methods for using SUPERASSIST would include twenty building projects from the north of Sweden. These projects should be expected to perform well on a sustainability related evaluation. Then a panel of experts would evaluate the projects and their results on SUPERASSIST and their results could be compared to the evaluation of the SMEs own design professional. Analysis of the data would include descriptive statistics as well as parametric comparison and differentiation tests. Ratings of the panel and the design professionals would be compared on sustainability performance. Age, gender and years spent in practice would also be taken into consideration.

This sustainability performance tool could be a quick and reliable tool for evaluating design and tackle bottlenecks in design related issues. Furthermore, this tool could be contributing to an open discussion for sustainability awareness and spreading the best practices in the design profession.

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