

Sustainability and Performance assessment and Benchmarking of Buildings SuPerBuildings – 244087 – Publishable summary

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PROJECT FINAL REPORT

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Final publishable summary report

Executive summary

The main objectives of SuPerBuildings were as follows: 1) to develop the potential of sustainability assessment and benchmarking methods in progress towards sustainable built environment, 2) to develop indicators for assessing the environmental, social and economic performance of buildings, 3) to develop criteria for the benchmarking of sustainable buildings (SBs), 4) to develop recommendations for the use of indicators in different stages of building process and in steering, 5) to disseminate the results for standardisation bodies, policy makers and construction professionals and encourage the development of SB services.

The focus was to develop understanding about assessment methods and performance levels paying special attention on the validity of indicators and the comparability of assessment results. Validity determines whether the indicator truly measures what it was intended to measure or how truthful the results are. The outcomes of the research work suggest that a top-down approach should be followed in the selection of indicators in order to ensure the validity of sustainability assessments. Two main criteria for individual indicators are: Sustainability indicators of buildings must indicate an issue of concern of sustainable development; buildings must have a significant impact on that issue of concern.

The goal of the project was not to develop a uniform assessment system with a defined list of indicators but the aim was to support the further development of existing systems. The discussion focused on indicators for which there are still lack of information about different factors (e.g. carbon footprint) or methodological issues (e.g. land use) and on indicators that are missing at the moment (e.g. in the field of economics). SuPerBuildings selected the following indicators: 1) Rational use of water, 2) Consumption of non-renewable primary energy, 3) Land use, 4) Global warming potential, 5) Construction and demolition waste generation, 6) Water pollution due to material leaching, 7) Hygro-thermal comfort, 8) Visual comfort, 9) Indoor air quality, 10) Cultural heritage, 11) Aesthetic quality, 12) Life cycle costs, 13) Long term stability of value.

The project showed that there is a lot of – especially local – understanding about the typical and best performance values of different building regarding certain sustainability indicators. However, much work is still needed to improve understanding of benchmarks and also to develop good processes for the determination of benchmarks. The possible sources for benchmark values depend on the type of the benchmark and can be outlined as follows: a) Target values: political targets, technical optimums, economic optimum; b) Best practice value: best practice, upper quartile; c) Reference value: median value; d) Limit value: legal minimum, prescriptive minimum.

SuPerBuildings studied the effective use of sustainability indicators in different stages of building processes. The description of the process and the recommendations were given for the following stages: 1) customer briefing for SB, 2) programming for SB, 3) bidding for SB, 4) design for SB, 5) implementation for SB, 6) use and maintenance for SB.

The project studied the ability of BIM to provide the needed input information in order to calculate the indicator values. The BIM is a concept that represents a way of working based on integrated exchange via ICT solutions. To allow such exchanges, a specific open standardized language has been developed (IFC). The work results show that many of the indicators are already supported by the IFC4 but there are still some gaps. The combined use of IFC4 and Information Delivery Manual (IDM) provides the right tools to ensure the technical and semantic integration of SuPerBuildings indicators to the BIM.

SuPerBuildings defined that an effective steering mechanism a) has an impact on its focus area, b) has support from the citizens and building owners, c) is feasible because tools needed in assessment and verification are available and accessible for all who need those and because guidelines and instructions needed are clear. The project dealt with the following types of instruments: 1) normative control and regulatory instruments, 2) informative control and regulatory instruments, 3) economic and market-based instruments, 4) fiscal instruments and incentives, 5) support and information, 6) municipal steering. SB indicators are mature enough and should be actively be brought to guide all life cycle phases of buildings. The following recommendations were formulated: Comprehensive understanding about the goal, Guidelines for planning and design, A wider scope for regulatory instruments, Development of municipal support and building supervising processes, Development of substantiation processes in performance based procurement, Further economic support for the refurbishment of existing buildings.

A summary description of project context and objectives

The main objectives of the SuPerBuildings project were as follows:

- To develop a common understanding about the potential of sustainability assessment and benchmarking methods in progress towards sustainable built environment
- To develop indicators for assessing the environmental, social and economic performance of buildings
- To develop criteria for the benchmarking and labelling of sustainable buildings (SBs)
- To develop recommendations and solutions for the use of the system in different stages of building process and in steering and building regulation
- To disseminate the results for standardisation bodies, policy makers and construction professionals and encourage the development of new sustainable building services

The premise of the project was that it is possible to

- develop a logical structure for the sustainability assessment of buildings considering the environmental, economic and social performance of buildings;
- define core indicators for SBs;
- effectively use indicators in building processes;
- use sustainability indicators as an instrument of SB building steering

and thus promote design and construction for sustainable built environment.

The project is divided into the following 8 work packages:

- 1) WP 1 Management of consortium
- 2) WP 2 Establishment of the common starting point for the project
- 3) WP 3 Potential of SB benchmarking systems
- 4) WP 4 Assessment of sustainability performance of buildings
- 5) WP 5 Performance levels and benchmarking criteria
- 6) WP 6 Recommendations for effective exploitation
- 7) WP 7 Piloting
- 8) WP 8 Dissemination

SuPerBuildings project developed and selected sustainability indicators for buildings; improved the understanding about performance levels considering new and existing buildings, different building types and different national and local requirements; developed methods for the assessment and benchmarking of SBs; and made recommendations for the effective use of benchmarking systems as instruments of steering and in different stages of building projects. The framework for the assessment of environmental, social and economic performance is being developed within CEN and ISO. SuPerBuildings considered the output of the standardisation processes and focused on the development of the validity of SB indicators, comparability of assessment results, benchmarking criteria and the usability of project also provided recommendations for the improvement of standards.

State-of-the-art

The project collected information about the availability of sustainability indicators and assessment methods in order to make conclusions about the needs for the further development and harmonisation. CEN and ISO standards are based on a life-cycle analysis based approach supplemented by additional environmental and technical information. The current standards focus on environmental performance assessment, though methods for the assessment of social performance are under development. The SBA and UNEP initiatives focus on a much narrower set of metrics than included in the standards. LEnSE project identified 31 environmental, social and economic issues. The current Perfection project focuses on setting up a framework and a set of indicators for the overall quality of the indoor environment of buildings. Eleven national building evaluation tools were reviewed and analysed with regard to the availability of sustainability indicators and assessment methods and their degree of common understanding. The following table shows the issues not covered and the most common covered issues.

Overview of issues and indicators within the building evaluation tools considered by the partners as missing or to be (further) developed.		
Environmental indicators	Economic indicators	Social indicators
<ul style="list-style-type: none"> • LCA indicators: <ul style="list-style-type: none"> - photochemical ozone creation potential - abiotic depletion - biotic depletion - human toxicity - eco-toxicity - materials - use of wood • Ecological value of the site: <ul style="list-style-type: none"> - landscape degradation - evaluation of site ecology - ecological footprint • Waste and radioactive waste • Needs for irrigation 	<ul style="list-style-type: none"> • Lifecycle costs • Flexibility/adaptability 	<ul style="list-style-type: none"> • User related indicators: <ul style="list-style-type: none"> - consideration of user's needs - individual lifestyles and preferences - usability • Protection from domestic accidents • Space efficiency • Building aesthetics and context
Overview of most covered issues and indicators within the building evaluation tools.		
Environmental indicators	Economic indicators	Social indicators
<ul style="list-style-type: none"> • Primary energy consumption • Minimise water consumption • Materials • Waste production during the use phase • Global warming potential • Ecological value of the site 	<ul style="list-style-type: none"> • Building adaptability • Ease of maintenance 	<ul style="list-style-type: none"> • Indoor air quality • Provision of safe and adequate bicycle lanes and facilities • Visual comfort • Thermal comfort • Acoustic comfort • Access to public services and amenities • Access for users with physical impairments • Access to public transport

All analyzed tools have performance rating scale at indicator and building levels. However, considering the lack of some indicators, the further development of both performance levels and benchmarking criteria is also required. Most of these tools have a single global score as the result of a total aggregation process with weighting factors. Most of them are based on a four-level aggregation scheme. The consistency of the final set of criteria and the establishment of rules that clearly define weighting factors based on rational arguments and intermediate levels of aggregation should be further developed.

Barriers and drivers

SuPerBuildings studied barriers and drivers for sustainable building and stakeholder needs with regard to assessment methods. The study of literature summarised the research results concerning the barriers and potentials of sustainable building. The biggest challenges concern the following sections: Steering and regulations, Demand and the role of owners, Tendering and procurement processes, Availability of integrated methods, Cooperation and networking. The target groups of the interviews were the members of the project groups (research group, stakeholders' group, network group) and participants of two sustainable building conferences. The results indicated that in general sustainability assessments are at present very important for architects and designers, building authorities and planning authorities. On the other hand, it seems to be currently of low importance for insurers, banking sector and community representatives.

Development of indicators

The goal of the project was not to develop a uniform assessment system with a defined list of indicators but

the aim was to support the further development of existing systems. The discussion focused on indicators for which there are still lack of information about different factors (e.g. carbon footprint) or methodological issues (e.g. land use) and on indicators that are missing at the moment (e.g. in the field of economics). SuPerBuildings selected the following indicators: 1) Rational use of water, 2) Consumption of non-renewable primary energy, 3) Land use, 4) Global warming potential, 5) Construction and demolition waste generation, 6) Water pollution due to material leaching, 7) Hygro-thermal comfort, 8) Visual comfort, 9) Indoor air quality, 10) Cultural heritage, 11) Aesthetic quality, 12) Life cycle costs, 13) Long term stability of value.

Performance levels and benchmarking

One of the objectives of SuPerBuildings was to develop knowledge on typical performance levels. Seven key indicators were selected for that purpose, and these were the objects of an inventory of accurate and actual data, based on statistical studies, regulation standards, voluntary schemes, or even case studies, across seven European countries: Land Use, Energy Consumption, Greenhouse gas emissions, Water Consumption, Waste production, Hygro-thermal comfort, and Indoor Air Quality.

SuPerBuildings project showed that there is a lot of – especially local – understanding about the typical and best performance values of different building regarding certain sustainability indicators. However, much work is still needed to improve understanding of benchmarks and also to develop good processes for the determination of benchmarks. The typology of benchmarks can be combined with values from appropriate sources. The possible sources for benchmark values depend on the type of the benchmark and can be outlined as follows: a) Target values: political targets, technical optimums, economic optimum; b) Best practice value: best practice, upper quartile; c) Reference value: median value; d) Limit value: legal minimum, prescriptive minimum.

Sustainable building processes

The effective use of SB assessment and benchmarking systems in different phases of building processes requires the availability of needed information, communication and information flows between different actors of the process, and possibility also new services, new roles and new actors. The recommendations for the use of sustainability indicators in building processes were developed through a series of workshops with experts. The description of the process and the recommendations were given for the following stages: 1) customer briefing for SB, 2) programming for SB, 3) bidding for SB, 4) design for SB, 5) implementation for SB, 6) use and maintenance for SB.

BIM

The sustainability indicators that were developed by the consortium were checked against their potential integration to BIM. This means to answer three questions: 1) does the BIM be able to provide the needed input information in order to calculate the value of the indicators? 2) does the BIM be rich enough to have already concepts well suited to support the indicators (definitions and corresponding values)? 3) is-it enough to ensure consistency of information?

The BIM is an approach, which represents a way of working based on integrated exchange via ICT solutions. To allow such exchanges, a specific open standardized language has been developed - Industry Foundation Classes (IFC). All the construction elements that are needed to determine the value of the indicators are already present in the IFC. In its recent update (IFC4) this language has been greatly enriched especially with regards to sustainable assessment. The work results show that many of the indicators are already supported by the IFC4. There are still some gaps as some indicators are not supported and some others are weakly supported. However, it is not enough to ensure the consistency of the information among the various exchanges and over the phases of a construction project. There is also a need for a formalised description of the assessment processes. In order to perform such task and in order to keep the link with the BIM and the IFC, a dedicated methodology has been developed by the BuildingSmart association. This method based on the production of interchange manuals is called IDM (Information Delivery Manual). The combined use of IFC4 and IDM provides the right tools to ensure the technical and semantic integration of SuPerBuildings indicators to the BIM.

Steering

SuPerBuildings defined that an effective steering mechanism a) has an impact on its focus area, b) has support from the citizens and building owners, c) is feasible because tools needed in assessment and verification are available and accessible for all who need those and because guidelines and instructions needed are clear. The project dealt with the following types of instruments of steering: 1) Normative control and regulatory instruments, 2) Informative control and regulatory instruments, 3) Economic and market-based instruments, 4) Fiscal instruments and incentives, 5) Support and information, 6) Municipal steering, Steering actions in city planning and land use.

The researchers of steering instruments seldom recommend a single method but often a combination of methods is recommended. Many researchers emphasize the importance of regulatory methods. However, they also suggest the use of these in the combination of awareness raising campaigns and economic incentives. The true impact of the voluntary methods on the impacts of buildings on sustainable development has remained quite low. The reasons for this may be that the methods are often used in limited market segments and the required performance levels may not be ambitious. There is a need to understand and explain the linkage between property value and issues of sustainable development in order to promote the wide use of methods. There is also a need to get more knowledge about the real and desired performance levels of buildings in order to show real benchmarks for those who aim at the development of sustainability of buildings. When considering new policies and policy instruments it is important to assess the position of different stakeholders with regard to such policies and instruments. A good support from relevant stakeholders contributes to the effectiveness of policy instruments. Indicators of sustainable design and construction SB assessment systems are mature enough and should be actively be brought to guide all life cycle phases of buildings.

Future prospects

It is estimated that the demand for results of a sustainability assessment of buildings will grow even more in the coming years. Both voluntary processes as well as policy steering and municipal steering instruments need sustainability assessment methods and indicators. The project summarised that possible reasons for an increased need for assessment results and assessment tools are seen in:

- the concern about greenhouse gases and the knowledge about construction sector's potential in the reduction of GHGs may lead to the further development of regulatory and fiscal instruments;
- the intention of the public sector to become a role model, leading to an integration of sustainability aspects into the procurement process;
- the intention of cities to search for significant savings in energy consumption and GHGs, which may lead the increased consideration of sustainability aspects in building supervising processes;
- an integration of sustainability aspects into the analysis and management of large building stocks (portfolio analysis and portfolio management concerning both private and public owners and developers), leading to a demand for different system variants for the use phase (sustainability assessment – in use);
- an integration of sustainability aspects into the risk analysis and valuation, leading to a demand for disaggregated assessment results;
- the integration of sustainability aspects into the establishment of conditions for the financing and insurance of buildings leads to a demand from banks and insurance companies;
- companies want to integrate information on the sustainability of their corporate offices and building stocks into the sustainability report and need information;
- sustainable property funds give emphasis on a positive sustainability assessment as a condition for the purchase of objects;
- an integration of sustainability aspects into planning and architectural competitions, leading to the question of suitability of rating systems for early stages of planning;
- an integration into the planning process, which must lead to a development of new approaches;
- sustainable buildings increase the user satisfaction and productivity.