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Oct 31st, 3:30 PM - 5:00 PM

### Building materials and environmental indicators for urban planning-exposure

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#### Recommended Citation

Syla, Afrim, "Building materials and environmental indicators for urban planning-exposure" (2020). *UBT International Conference*. 233.

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# **Building materials and environmental indicators for urban planning-exposure**

## **Abstract**

Sustainable development is a key component in urban studies. The sustainability of buildings has become a headline topic in recent years. Buildings do not exist in isolation from their environment, however, but are integrated with infrastructure. In defining sustainable buildings, the issue arises how to incorporate the influences of not only user behavior, building design and technologies, but the associated infrastructure that comprises the entire built environment. The built environment considered here includes all buildings and infrastructure, and in this context, comprises approximately 10% of global GDP. The building and construction sector alone is not only the largest consumer of natural resources, in terms of both land use and materials extraction, but is responsible for 30-40% of global primary energy use and greenhouse gas (GHG) emissions. An important element in the implementation of sustainability goals in the built environment is the availability and dissemination of quantified knowledge about the effects that the construction, use, maintenance, and decommissioning of buildings and infrastructure are having on the environment. One approach to making that knowledge available and useful in the pursuit of sustainability is through the use of indicators. Indicators can be defined as variables that have been chosen for their ability to describe specific characteristics in the state of a system. Many sets of indicators have been developed, and then utilized independently or aggregated into indices to assess different components or aspects of sustainability,

While many of these indicator sets and indices incorporate segments of the built environment into their analyses, none of them incorporate a complete and specific set of indicators.

**Keywords:** sustainability, indicators, infrastructure, built environment.

## **Introduction**

At the 1992 United Nations Conference on Environment and Development in Rio de Janeiro the contract parties commonly acknowledged the concept of sustainable development as a response to the environmental, social and economical challenges the

world is facing today. This approach of tackling economic, social and environmental issues in an integrated approach and anchoring their consideration institutionally was concretised in the 'Agenda\_21' – the action programme of the United Nations for the twentyfirst century.

#### Objective and scope of the study

The objective of this study was to explore:

- if (and to what extent) consensus on environmental indicators for buildings as 'a common language for green building' can be reached among the core actors local building authorities, professional clients, client consultants, project designers, administrators of buildings and developers of environmental indicators for buildings; and

- what environmental indicators for buildings that are acceptable as 'a common language for green building' for the relevant actor groups could look like. To reach this objective the study investigates

- the environmental effects of buildings from a life cycle perspective

- the major decision-making situations in a building's life cycle: what is the environmental relevance of the decisions taken, who are the relevant actors and which environmentally relevant data are available?

- existing indicator systems: Which indicators and indicator systems are already in use, what is their scope with regard to environmental issues, decision-making situations and target groups?

#### Environmental issues:

The impacts of environmental factors on the degradation of building elements (for example disintegration of roof coverings caused by acid rain) were not within the scope of this study. Besides this no further demarcation with regard to other environmental issues considered was defined beforehand. Instead, it was part of the investigation to study, which environmental issues are considered relevant by the different actor groups. As the study focuses on indicators as a means of describing the environmental effects of buildings, economic implications of environmental measures or possible linkages between environmental indicators and economic aspects are not within the scope of this investigation. Actors: This study focused first and foremost on the following professional actors in the building sector<sup>10</sup>, who directly take environmentally relevant decisions:

- Local building authorities, represented by the municipality officers in charge of planning, building and environment;

- Professional clients

- Project designers

- Client consultants

- Administrators, that is those, who manage or deal with the operation, maintenance and renovation of existing buildings at higher levels, for example in the administration of co-operative housing societies or the building departments of municipalities and

- Developers of environmental indicators for buildings / building researchers.

The study's subject: What is an 'indicator'?

Research can be understood as an iterative intellectual journey between the two poles of the abstract and the concrete. As the starting point of this journey in this section I elucidate the subject of this study

– 'environmental indicators for buildings'

– in an abstract way. What is an 'indicator'? What is an 'environmental indicator for buildings'? What does the notion 'environment' mean in this context and which understanding of 'the environment' do we imply if we use 'environmental indicators'? If 'environmental indicators for buildings' are to tell us something relevant about the reality 'environment' and the reality 'building'.

Research tasks and methods

It is characteristic of this study that it enters into two spheres of scientific reasoning: the environmental scientific sphere and the social scientific sphere. Of course in the analysis of the relevant social groups SCOT's symmetry principle is applied. A study on environmental indicators for buildings, however, has to also elucidate the environmental side of the coin. In this study this is done from the environmental scientific perspective, well aware of the fact that in the social constructivist approach this perspective is only one specific perspective held by a specific relevant social groups among other perspectives held by other groups. The reason for doing so is simply that the environmental scientific perspective could be predicted to offer most knowledge about 'the environment' and this in a structured way. Thus it could serve as a point of reference for the environmental foci of the other relevant social groups, whose view at 'the environment' could be anticipated to be less elaborated in terms of detailed, structured and documented environmental knowledge.

Hazardous substances

Many of the diseases and disorders in the human population as well as in ecosystems in general that are attributed to the 'environment' are caused by toxic chemical compounds. The environment (air, water, solid waste, etc.) provides the pathways from the source of these chemicals to the affected organisms. Even though the notion 'hazardous substances' usually means chemicals that are known to lead to especially serious disorders even in small concentrations.

The indicator systems in the scope of this study can be distinguished into three different indicator-principles: life cycle assessment (LCA), checklist indicators and input-output indicators. All systems consider energy and emissions to air, while the other environmental issues are only considered by some of the systems.

Summary and conclusions

Now it is time to return to the research questions posed in the introduction. The objective of this study was to explore:

– if (and to what extent) consensus on environmental indicators for buildings as ‘a common language for green building’ can be reached in the near future among the core actors local building authorities, professional clients, client consultants, project designers, administrators of buildings and developers of environmental indicators for buildings and

– what environmental indicators for buildings that are acceptable as ‘a common language for green building’ for the relevant actor groups could look like.

To answer these questions, the results from the separate research tasks are recapitulated. Core results and core conclusions drawn from the results are displayed in separate tables for better readability. Results from the research task in the environmental scientific sphere. The separate research tasks that have been investigated in the different papers of this study to answer the overall research questions revealed the following results: Environmental effects of buildings and environmental relevance of the decision-making situations. The investigation of the environmental effects of buildings and of the three decision-making situations, based on a literature survey and the qualitative interviews with the representatives of the different actor groups, showed that buildings contribute to a broad spectrum of environmental effects. From the environmental scientific point of view it is therefore not justifiable to use, for example, ‘energy consumption’ as a representative indicator for a building’s total environmental performance. All phases of a building’s life cycle are environmentally relevant. Indicators should therefore cover all life cycle phases of a building. The description of the three decision-making situations in the scope of this study: sitting of the building, project design and renovation illustrated that all three are environmentally relevant but differ with regard to the environmental ‘hot spots’ and the actors.

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