ABSTRACT

The CIBW82 project: Sustainable Development and the Future of Construction studied the consequences of sustainable development to the construction industry in the future. That study concluded "the next step should be to reach a more consensus vision through a global common model and to set up indicators and policies to translate this vision into reality".

Measurable indicators are needed to set targets and to monitor the performance of the built environment. Decision-makers and policy-makers may use the indicators to evaluate economically viable and technically feasible strategies to improve the quality of life. Different actors in building processes may use the indicators as guidelines and tools to improve current practises and to improve the quality of construction. The indicators can be used for measuring the performance of building projects, different actors or diverse regions.

A new CIBW82 project on construction related performance indicators cover both qualitative and quantitative issues. The focus is in sustainability covering environmental, economic, social, cultural and institutional aspects. The indicators have a common structure at the international level, but different weights at a national level. The indicators are validated in pilot cases.

This paper describes the current status of that project aiming at a comprehensive methodology to achieve a sustainable built environment. It results in a full set of validated performance indicators with relevant information and guidance for its measurement in a continuous improvement process.

KEYWORDS:

Building design, performance indicators, sustainable construction.

INTRODUCTION

This paper discusses features of performance indicators for sustainable building and describes the objectives and current state of the Construction and City Related Sustainability Indicators (CRISP) Thematic Network (EC Contract N°: EVK4-CT-1999-20002). The French and Finnish building research organizations (CSTB and VTT Building Technology) manage CRISP. The network has 22 members from 15 European countries: Austria (Austrian Institute for Applied Ecology, Wien University of Technology), Belgium (Centrum Duurzam Bouwe, CSTC), Denmark (SBI), France (Energie-Cités, La Calade), Germany (FhG Institut für Bauphysik), Greece (Aristotle University of Thessaloniki), Hungary (EMI Plc), Ireland (Dublin University of Technology), Italy (University of Florence), the Netherlands (TNO-Bouw, W/E Consultants), Norway (Norwegian Building Research Institute), Romania (Urbanproiect), Spain (Universita Politecnica de Catalunya), Sweden (Chalmers University of Technology, Royal Institute of Technology) and United Kingdom (BRE Centre for Sustainable Construction, BSRIA, University of Salford).

The EC-funded CRISP network takes results of the CIBW82 (www.cibworld.nl, 2000) project Sustainable Development and the Future of Construction (CIB, 1998) and the CIB Agenda 21 on Sustainable Construction (CIB, 1999) as a starting point. CRISP will define and validate performance
Indicators for sustainable building that was set as an objective in a planned CIBW82 project. CRISP (cic.vtt.fi/eco, 2000) is a three year Network that started its operation in spring 2000 and it will accomplish its task in 2003.

PERFORMANCE INDICATORS

Building performance can be expressed in a form of values of parameters that can be measured. Setting precise objectives and verifying explicit conformity of sustainable buildings or sustainable built environment is often very complicated and time consuming. In many cases simple indicators are needed to give guidance based on preliminary drafts and concepts when sufficient data is not available for decision making.

Indicators can give information about complicated systems in a simple form supporting discussion about these issues with non-experts who need to understand them quickly. Indicators help also explaining how phenomena have changed along with time and how they have developed in relation with set objectives. An indicator can be presented as a synthetic variable, giving indications, describing or measuring the state of phenomenon or a situation. Indicators reflect cause-to-effect relationship between an action and its consequences. Indicators can also be presented as conceptual tools, expressed in clear and precise terms measuring progress towards the objective, providing a measurement unit through which modelling and monitoring can be conducted.

Sustainable building performance indicators are especially appropriate when good direct measures are lacking, which may be the case with social, cultural or biodiversity aspects. In strategic planning or in the early development phase sufficient information is not often available to make a complete analysis. In big and complicated projects with limited assessment resources, indicators can serve well. They fit also for describing activities that have indirect consequences on impacts, e.g. management indicators for estimating sustainability performance of activities or actors.

An indicator must be relevant and effective. Some of them may present an aggregation of sub-indicators. An indicator has to meet requirements such as relevance, sensibility, objectivity, measurability, accessibility or readability. Characteristics of an appropriate and effective indicator include the following: relevant to specific project or program, clear linkage to a goal and objective, understandable for project team and community, focused on a long range view, based on reliable information, measurable by a standard method, appropriate data exists and is accessible. The challenge in developing and applying indicators, instead of aiming at precise performance values, is to avoid oversimplifying the system so that important information does not vanish and the whole picture become obscured, to minimise misleading use of indicators.

EXAMPLES OF INDICATORS

Some examples of indicators are listed below as picked from the UN working list of indicators of sustainable development (www.un.org, 1996) arranged in different categories (social, economic, environmental, institutional) corresponding to different Agenda 21 chapters and structured to present driving force, state or response.

CATEGORY: ENVIRONMENTAL

Chapter 10: Integrated approach to the planning and management of land resources

DRIVING FORCE
  - Land use change

STATE
  - Changes in land condition

RESPONSE
  - Decentralized local-level natural resource management
Chapter 15: Conservation of biological diversity

**DRIVING FORCE**
- Threatened species as a percent of total native species

**RESPONSE**
- Protected area as a percent of total area

Chapter 18: Protection of the quality and supply of freshwater resources

**DRIVING FORCE**
- Annual withdrawals of ground and surface water
- Domestic consumption of water per capita

**STATE**
- Groundwater reserves
- Concentration of faecal coliform in freshwater
- Biochemical oxygen demand in water bodies

**RESPONSE**
- Waste-water treatment coverage
- Density of hydrological networks.

The UN indicator list should be seen as a flexible set of indicators from which countries may choose indicators according to national priorities, problems and targets. The *driving force* indicators indicate human activities, processes and patterns that impact on sustainable development. The *state* indicators indicate the state of sustainable development and the *response* indicators indicate policy options and other responses to changes in the state of sustainable development. Interpretation, validation and further development of these sustainability indicators have led to different sets of national indicators, like in Finland (www.vyh.fi, 2000) that are structured to cover ecological, economic and socio-cultural issues.

**CRISP NETWORK**

The CRISP Network aims at co-ordinating research work dealing with defining and validating such indicators, implementing them to measure the sustainability of cities, construction projects (buildings and built environment) and the progress of activities dealing with creating and maintaining them at a national level. The objective is to compare the sustainability of individual buildings and groups of buildings at the urban and suburban levels, urban areas and construction activities at the scale of a city, a region or a country.

The network leans on a carefully selected set of 24 skilled teams that bring results achieved in their national and international projects in this field. In each participating country, covering widely the European dimension, the team members are developing and implementing the principles of sustainable development to the city and construction sectors. Consideration of different dimensions of the sustainable development concept is assured through a dialogue with the countries in transition economies and with the developing countries.

The Sustainable Construction concept aims at the creation and responsible management of a healthy built environment based on resource efficient and ecological principles. It takes account of environmental and life quality issues, social equity and cultural issues, and economic constraints. Sustainability indicators constitute one of the bottlenecks in moving towards more sustainable construction and cities. Indicators are needed to precisely define sustainability criteria and to measure the performance of the construction industry and the built environment. Decision-makers and policymakers need indicators to evaluate economically viable and technically feasible strategies to improve the quality of life, whilst at the same time increasing resource use efficiency. Numerous actors in the construction and development process need tools and guidelines based on indicators to improve current practices and the quality of construction.

The network aims to co-ordinate current research work defining and validating such indicators and implementing them to measure the sustainability of construction projects (buildings and built
environment) in cities. This includes the activities of identifying and maintaining indicator sets together with implementing them to compare sustainability at a number of levels: individual buildings, large groups of buildings at both the urban and suburban levels as well as for whole urban areas. Implementation in construction activities at the scale of a city, a region or a country is also to be explored.

![Diagram of CRISP framework in sustainable development process](image-url)

**Figure 1. CRISP framework in sustainable development process. (Huovila & Bourdeau, 2000)**

**APPROACH AND SCIENTIFIC OBJECTIVES**

CRISP links together skilled teams from a wide range of national and international projects in this field from across the breadth of Europe. The main activities of the network are to define a framework and general methodology for construction and city related sustainability indicators, stimulate and coordinate the development of such indicators, gather and organise indicators within a database including information on validation, testing and criteria of use. Wide dissemination of the results of the research will also be ensured.

In order to facilitate the use and uptake of these indicators, dissemination takes place through a Newsletter, an active website meeting the needs of the end users. Regular conferences and meetings will conduct discussions with a range of different target groups. Four sub-areas are to be addressed by four teams or clusters: the product cluster, the building cluster, the urban blocks cluster and the process/strategy cluster.
EXPECTED IMPACTS

CRISP aims to develop and validate harmonised criteria and relevant and efficient indicators to measure the sustainability of construction projects particularly within the urban built environment. Through the range of indicators, which will be dealt with, the project will contribute to improve the quality of life in urban communities and to promote sustainable development assessed in economic, architecture, environmental, social and cultural terms. Challenges which will be considered through the indicators are for instance linked to the preservation of natural resources, air quality, noise, health and safety, waste, economic competitiveness, employment, deterioration of infrastructure, urban sustainability, environmental loads of construction, socio-cultural aspects etc.

Other impacts include better co-ordination of the development of sustainability indicators for construction and cities. Improved consensus on the indicators and on the criteria of their use, better understanding and application of these indicators is planned to be achieved by relevant end-users such as planners, developers, designers, standardisation bodies, authorities, contractors and materials producers. These end-users will benefit from an authoritative, relevant and agreed source of information on indicators. It will enable them to develop more appropriate performance targets, tools and standards in order to improve the level of sustainability of the built environment.

PROGRESS AND ACHIEVEMENTS

The network was kicked off in June 2000 in France. The first task was to exchange information concerning the ongoing projects in that field, to launch the state-of-the-art-reporting task and to discuss already the indicator framework.

The planned networking process includes active interaction with local end users taking into account ongoing development, national constraints, local priorities and building practises. Compilation of national state-of-the reports and forming of the end-user network is in progress.
The starting point for the indicator framework is taken from the known international or national classifications or lists of indicators. Further development of the framework and collection of indicators and is now going on and will be tested in different countries, economies and environments at a later stage.

| indicator system | environmental | economic | institutional\n|------------------|---------------|----------|----------------|
| (example)        |               |          | social, cultural |
| BUILDINGS        |               |          |                 |
| primary          |               |          |                 |
| supplementary    |               |          |                 |
| PERFORMANCE OF ORGANISATIONS | | | |
| actors           |               |          |                 |
| - owners         |               |          |                 |
| - developers     |               |          |                 |
| - designers      |               |          |                 |
| - contractors    |               |          |                 |
| - product producers |           |          |                 |
| BUILT ENVIRONMENT |               |          |                 |
| STATE / INTERACTION |             |          |                 |

Figure 3. CRISP networking process organisation

Figure 4. An example of an indicator system
CONCLUSIONS

Sustainability indicators are needed to evaluate the state and progress of buildings and cities. CRISP network is one attempt to create a common indicator framework, and to define and validate set of indicators. The three-year network has only started with 24 organizations from 15 European countries. It's willing to change information with other continents, countries and organizations in order to achieve common tools to improve the sustainability of our environment.

REFERENCES


