Methods to Estimate Stakeholder Views of Sustainability for Construction Projects.

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ABSTRACT: The new challenge for a construction project management is to meet the demands of sustainable construction, defined by ecological, economical, social and cultural variables. During a facilities lifecycle various activities involves a significant number of stakeholders. It could be those stakeholders who directly are involved, e.g. architects, facility managers or users, and those who more or less are affected by the project(s), e.g. the public. Each of these differs in their views of sustainability in general terms and in the view of the actual project. Based on the sustainability subgroups; ecology, economy, social, and culture, a profile of each stakeholder may be obtained. This can help the project management team to take a more, in a sustainability view, correct course of action in their decision process. The purpose of this study is to examine methods for estimating and evaluating views and opinions on sustainability from the various stakeholders, and discuss the possible applications for these methods, and how they need to be adapted to be suitable tools in construction project management.

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INTRODUCTION

The construction sector has a huge impact on our environment and of us as human beings. The sector consumes a considerable part of our limited resources as energy, raw material, water and land. A construction project has to meet the demands of minimising the impact on our environment and optimising the impact on ourselves. These demands are a way towards a sustainable development.

The new challenge for a construction project management is to meet these demands of sustainable development in the concept of sustainable construction, defined as [1]:

"... the principles of sustainable development are applied to the comprehensive construction cycle, from the extraction and beneficiation of raw materials, through the planning, design and construction of buildings and infrastructure, until their final deconstruction and management of the resultant waste. It is a holistic process aiming to restore and maintain harmony between the natural and built environments, while creating settlements that affirm human dignity and encourage economic equity."

According to definitions of sustainable development and the Agenda 21, the development of sustainable construction involves ecological, economical, social and cultural variables.

Attention must be paid to the issue of sustainable construction in all the decisions arising out of the complex web of considerations associated with a construction project. The obstacle is that sustainable construction is cross-disciplinary, concerning a multiple number of factors and stakeholders, which has to be considered in order to achieve sustainable solutions and alternatives. In this process several evaluation tools are used. However, a single tool does never consider the whole aspect of sustainability, and is often used by different stakeholders independent of each other.

The problem is that project frames often are set in the early stages of the construction project, without consideration to the issues of sustainable construction. Thus, there is a need to systematically combine different tools and methods of evaluating sustainability, during the project life cycle.

2. THE STAKEHOLDER DIMENSION

Project stakeholders are defined as, individuals and organisations who are actively involved in the project, or whose interests may be affected by the execution of the project or by a successful project [2]. The implication is that a stakeholder is any individual or group with power to be a threat or a benefit [3]. The stakeholders in a project can be divided into internal and external stakeholders. The internal stakeholders are those who are members of the project coalition or who provide finance; the external stakeholders are those others affected by the project in a significant way [4].

An important part of the management of the project systems environment is an organised process to identify and manage the probable stakeholders in that environment, and determine how they will react to the project decisions [5].

The stakeholder dimension of sustainability, mainly is to determining the social aspects of sustainability, in combination with the economical, ecological and cultural aspects. The social aspects of
the project must be fully considered and integrated into decision making [6]. In introducing “AccountAbility 1000: a new social standard for building sustainability” Becket and Jonker [7] states that organisation information requirements should be connected with the rapidly changing opinions, ideas and needs of stakeholders, in the process of gaining legitimacy for outcomes through their inclusion.

To effectively manage stakeholder interests it is not enough to just identify their demands and needs. Project management must also identify the relative power different stakeholders have on the implementation of the project. A method to do this is stakeholder mapping [8], an approach, which is adapted from the concept of environmental scanning [9]. A tool in stakeholder mapping is the power / interest matrix figure 1, which analyses the following questions:

- How interested is each stakeholder group to impress its expectations on the projects decisions?
- Do they mean to do so? Do they have the power to do so?

![Figure 1: Stakeholder mapping, the power / interest matrix](image)

### 3. EVALUATION TOOLS

There are a lot of useful tools, commercial or under development, for the construction sector regarding evaluation of environmental, economic and social assessment. Most of the tools are focused on the environmental assessment and economic evaluation. This section presents very brief some examples of tools.

#### 3.1 Environmental impact assessment tools

These kinds of tools are divided in LCA- (Life cycle analysis) or criteria- based tools or a combination of LCA and criteria-based tools. Boonstra and Dyrstad Pettersen [10] are mentioning for example a couple of the latter tools intended for existing buildings from various countries as NABERS (Australia), Miljöstatus (Sweden), Ecoprofile (Norway), Green Globes (Canada), HQE (France) and CASBEE (Japan).

Edwards and Bennett [11] presents some LCA-based tools mainly for the design stage of a construction project; Athena (Canada), Build-It (Germany), Building Environmental Assessment Tool 2000 (Denmark), Escale (France), LCA House (Finland), Eco-Quantum and Greencalc (The Netherlands), Eco-Effect (Sweden) and Envest: Environmental impact estimating software (UK).

Other tools with a combination of LCA and criteria according to SBIS [12] are the international GBTool, LEED and SpiRIT from USA, BREEAM (UK), Equer (France), OGIP (Switzerland) and Hong Kong Building Environmental Assessment Method.

Most of these tools are developed for the local market of each mentioned country [10] and apply credit systems unique for each tool. There are some concepts of assessment leading to certification. A more general instrument of determining environmental impact of materials “ecological rucksack”, is mentioned by Wallbaum and Buerkin [13]. With this rucksack as input it is possible to estimate resource productivity with the method of MIPS, a monitoring tool for material flows. COMPASS (companies’ and sectors’ path to sustainability) is a tool to provide the management sufficient information for integrated analysis and decisions [13]. Ecological footprint [14] is another method of estimating resource consumption. The footprint is expressed in an amount of land and water required to produce the resources and assimilate the waste a specific population consumes and generates.

#### 3.2 Economical tools

Evaluation of Life Cycle Costs (LCC) could be used in the sense of whether higher initial costs is justified by reductions in future costs (new building or replacement of elements in existing buildings) and if a proposed change is more cost-effective than the do-nothing alternative [15] There are some commercial LCC-tools (Life cycle cost) developed in USA [12]: BLCC, QuickBLCC and LCCID. In Europe there are examples of LCC-based tools as Cost Reference Model (the Netherlands), LifeCycle (UK) and GaBi3 (Germany).

LCC has become a popular way of solving environmental issues as for instance recycling and demolition costs [16]. However, Gluch and Baumann [16] argue that this may not be entirely appropriate since the LCC tool was developed to rank investment alternatives, and not to consider environmental concerns. “It is important to emphasise that a "traditional" LCC does not become an environmental tool just because it contains the words life cycle” [16].

Cole and Sterner [17] argues that the limited use of LCC is depending of the current design practice and data accuracy. The major role of the LCC is to provide the management of a better framework for decisions and evaluate specific choices.

Another economical tool, often used to evaluate different investment alternatives are Cost-Benefit Analysis. Cost and benefits can be evaluated on a variety of levels, Financial Appraisal (FA), Social Financial Appraisal (SFA), Cost-Revenue Analysis (CRA), Cost-Benefit Analysis (CBA), and Social Cost-Benefit Analysis (SCBA) [18].

The most basic level is the purely financial analysis, which basically assess the impacts of different alternatives on the organisations own financial cost and revenues.

When it comes to assess more than the purely financial impacts, an CBA or SCBA is often used, which tries to value the environmental, social and cultural impacts of different alternatives in monetary
terms together with purely economical factors. These tools are often used to assess public investments and thus trying to evaluate the full impact of different alternatives in monetary terms.

In practice it is hardly ever realistic to value all the costs and benefits of options in monetary terms. Most cost-benefit analyses will incorporate some additional items which it is either not possible to value, or not economic to do so. But where the most important costs and benefits have been valued, the others can be set alongside and included in the decision process [19].

3.3 Social and cultural assessment

According to Barrow [20] there are techniques and methods of social impact assessment as social surveys, questionnaires, interviews, available statistic; census data, nutritional status data and findings from public hearings, operations research, social-cost-benefit analysis, the Delphi technique, marketing and consumer information, reports from social, health, crime prevention and welfare sources and field research by social scientists. Among these, the method of census and demographic data tend to be the easiest and causes few challenges and problems.

Environmental psychology issues of design and construction [21] points out the essential in participation of the involved stakeholders, especially the users, in the process of designing a construction project. One major aspect of the designing is terms of privacy, both the need of interaction and to allow not interacting. Optimisation also is needed for homogeneity and heterogeneity in neighbourhoods and separation of different land use: commercial and residential areas. Designing should consider better health, comfort, satisfaction, less crime and for peace.

3.4 Multi Criteria Analysis (MCA)

In decision concerning sustainability multiple factors are involved. Multi-criteria analysis establishes preferences between options by reference to an explicit set of objectives that the decision making body has identified, and for which it has established measurable criteria to assess the extent to which the objectives have been achieved [19,22]. The evaluation does not give an optimal solution because of the fact that one single alternative is rarely the best solution when regarding all criteria. The MCA gives the best compromised decision regarding all the relevant criteria.

Multi-criteria analysis (MCA) is one of the disciplines that have found a fertile ground in environmental applications. Managing the environment implies dealing with dynamic systems that are only partly understood, with multiple interests and multiple actors, with long-term implications that range from the local to the global scale [23]. In for instance the Netherlands, MCA is sometimes used to support the choice of alternatives in an EIA [24]

4. MODEL FOR EVALUATING SUSTAINABLE CONSTRUCTION

As the major part of the final cost of a construction project is set in the initial phase of the building process, the major part of the environmental and sustainability impact of the project is also fixed at the same time [25,26]. As the building process continues, the decisions made have less effect of the final cost and the final sustainability impact of the project.

The urban model [27,28] was developed to control the building process according to the principles for sustainable construction for the urban areas of industrial countries. Its purpose was to create a main thread of sustainability priorities throughout the building process. The model optimise the sustainability objectives and targets of the property owner's organisation and of the specific conditions of a actual construction project, related to the site and to the purpose of the project. The urban model is an important part of the complete management process of sustainable construction.

The main structure of the urban model consists of a verifiable sustainability programme, which is set as early as possible in the project process. The model includes measurable requirements, which are given priority from a sustainability point of view. The model is not supposed to be static with all its requirements fixed at the programme stage. The function of the model is to be dynamic and to allow requirements to be changed as decisions and conditions changes during the building process. After the end of a project, the model supports the planning of maintenance and could be used as a base of sustainability information for users and tenants. The model is compatible with most of the environmental management systems supposed to be used of a property owner's organisation.

The Stakeholder-Urban Evaluation (TURE) model presented in this paper is a proposal to systemise the issues of sustainable construction. The model is mainly based on the Urban model [27,28,29] and empirical studies on stakeholder management [30,31], supported with literature studies on tools for sustainability and environmental issues. Figure 2.

The principle can be described by four steps; stakeholder analysis, specific conditions for the actual application, the general conditions of the organisation, the sustainability programme and the application of the programme.
4.1 Stakeholder analysis
The stakeholder analysis should consider the following aspects:
1. Identify all potential stakeholders, external as well as internal.
2. Assess each stakeholders claim on the project, are they proponents or opponents in relation to the goals of the project.
3. Assess each stakeholders interest and power to influence project decisions.

The power/interest matrix (see figure 1) can be a useful tool to conduct the stakeholder analysis.

Some powerful stakeholder can use or provide economic instruments to promote sustainable construction, which can be divided in 10 categories according to Drouet [32].

These categories are:
1. Preferential credit conditions for sustainable buildings.
2. Reimbursement, rebate and investments aid offered by energy or water utilities, suppliers, equipment etc.
3. Preferential insurance conditions for sustainable buildings, new insurance products.
4. Setting up specialised funds for sustainable construction.
5. Fiscal bonus for the construction or renovation of Greenbuildings.
6. Heavier fiscal burden on non-sustainable construction.
8. Density bonus and/or accelerated building permit processing for sustainable construction.
9. Business rating indexes including sustainable building management criteria.
10. Trade of CO₂ -certificates.

4.2 General conditions
The general conditions of the organisation include the application-related conditions directly linked to the organisation and its way of working. One main condition is the organisation's environmental policy and environmental management system, including relevant parts of environmental objectives and targets. Another main condition is the social and cultural impacts of the external stakeholders influence. A third main condition is the economic conditions for the organisation (business related) and of the external stakeholders influence.

The general conditions of the organisation also include for the application relevant general descriptions, standard solutions, standard blueprints etc. according to the activities of the organisation.

4.3 Specific conditions
The specific conditions contain:
1. A sustainability review
2. An evaluation of significant sustainability aspects
3. Documentation made during the process

The sustainability review is a review of the conditions specific of the site and surroundings of the building described in ecological, economic, social and cultural terms. Input to this review is the demands of the internal stakeholders. Relevant tools from the toolbox of Evaluation Tools are used as instrument for the review.

With the sustainability review as a base, an evaluation of sustainability impacts is done and significant sustainability aspects are set. The evaluation considers only overall global and national objectives plus the internal stakeholders' demands.

In the process of documentations during the process changes the conditions for the application and the conditions for sustainability targets on a continuous basis.

4.4 Sustainability programme
The sustainability programme for the application is a result of an analysis and a prioritising of the specific conditions and of the general conditions. It consists of three main parts:
1. The sustainability objectives.
2. Prioritising of the sustainability objectives.
3. The sustainability targets.

The sustainability objectives for the application depend on the environmental policy, social impacts and the economic conditions of the organisation and the significant aspects of the sustainability review. These objectives decide the direction of the application in a sustainability point of view; it formulates the main thread of the application as regards sustainability.

Relevant tools from the toolbox of Evaluation Tools are used as instruments to evaluate the input.
aspects from specific conditions and general conditions. The organisation management decides and formulates the objectives according to the evaluation.

Prioritising of the sustainability objectives is a relative order of preference of sustainability objectives because of preparation for forthcoming relative conflicts and to meet other forthcoming demands of the application. The prioritising depends on the evaluation of the objectives and on the organisation’s ability to deal with the objectives. It is a decision of the organisation management.

The sustainability targets are sustainability objectives divided in detailed and measurable units from levels of system to levels of single components. The methods and rules of verification of the measurable sustainability targets are also established.

It is possible to adjust the sustainability targets during the process with confirmation in connection with documentation.

4.5 Applications

Using the above mentioned model, it is possibly to adapt the sustainability programme on several applications connected to the construction sector.

One possible application is a plan of sustainability and quality checks. It is drawn up by all players involved in a project, based on the projects verifiable sustainability targets and other quality requirements. The aim is to verify all the sustainability targets according to the methods mentioned in the sustainability programme for the project. Divergence and change of verification are a part of the projects documentation. The verifications act as the basis of the final documents for the project together with other documentation related to the project. From the final documents, sustainability information for the project is able to find its way to the property owner’s organisation for operation and maintenance, to users and to tenants, according to the organisation’s environmental management system. Furthermore this sustainability information can be used as input to sustainability indicators.

Another possibility is to use the model and the evaluation tools for a sustainability decision of alternative choices of methods, systems or components. The sustainability programme is a valuable input to MCA, EIA, LCC, CBA and other evaluation tools in order to make choices between different alternatives.

It is also possible to use the model and the toolbox for a single sustainability facility inventory or a more continuous sustainable real estate management, indicated by Persson [28].

5 DISCUSSION

Sustainable construction is cross-disciplinary concerning all the stakeholders involved in the construction process. It is the stakeholders who decide, directly or indirectly, the result of a certain application. It is essentially for the management of an application project to understand and deal with the stakeholders different views and demands.

Sustainable construction also deals with a multiple of other input and output factors. To reach a way of dealing with all these factors, it is necessary to systematise and evaluate those concerning global, regional, local and organisational constraints. But the evaluation process involves both quantitative and qualitative approaches. This cause a necessity to formulate boundary criteria that are, more or less, subjective to the organisation management. There are also a huge amount of different factors, often full of contradictions, to handle in the effort to create the optimum regarding result, time, quality and final cost.

The model described in this paper systematises the input of sustainability factors, depended on the stakeholders views and demands and on the specific constraints of the site or facility. Together with the organisations standards, evaluation and formulation of the sustainability objectives for the actual application.

The objectives are set in priority and then divided in measurable and verifiable targets. The model forces the organisation to choose the most relevant course of action to reach sustainability, with regard to the actual application and to the ability of the organisation itself. Furthermore, the model also meets the demand for continual improvement in the organisations’ environmental management system. It is also possible to formulate sustainable indicators at different levels and for different stakeholders. The indicators could be relative the organisation and/or connected with local, regional, national and global objectives.

There are a lot of evaluation tools on the market or on the way to the market and most of them are adapted to the special conditions of the national markets. Most of the tools are concerning environmental and economic issues. There is a lack of good and useful tools for social and cultural issues concerning sustainable construction, especially the stakeholders influences and demands.

Further research of methods that combines the quantitative factors of economy, ecology with the more qualitative social and cultural factors are needed to sufficiently deal with issues of sustainable construction. Case studies can be conducted to evaluate various methods and their applications. This approach could eventually lead to proposals of different sustainability indicators concerning sustainable construction.

REFERENCES