

Definition of an environmental performance evaluation system

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ABSTRACT

The work *Definition of an Environmental Performance Evaluation*, is the first, main step of the research activity *Life Cycle Approach to Architectural Building Designing. Definition of an Environmental Performance Evaluation System of Touristic and Receptive Facilities in Rural Mediterranean Areas*, a national interdisciplinary project co-financed by MIUR in 2002, on which the authors are working. The aim of the project is the lay-out of a computerized evaluation model of the environmental performances of touristic-receptive facilities in the rural Mediterranean areas, useful to orientate the project choices according to a viewpoint of environmental sustainability of buildings. Through strong integration between the disciplinary areas of Architecture and Informatics, this work aims at presenting the first relevant results obtained: mainframe of the current experimentations; pointing out of the transferability criteria of the selected experimentation into the research applicative field, and customizing of the user needs; initial structuring of the building and computing method of the federate Web-based database and implementation of the interface prototype for the data access; pointing out of the data mining technique and relative validation through the application of available data; first evaluation of the defined tool efficacy.

INDEX TERMS

Life cycle analysis; Power system; Sustainable rural tourism; Building materials; Environmental performance; Indoor air quality; Web-Based database; Data mining

INTRODUCTION

The wish to focus the research on the development of methods to verify the ecological compatibility of buildings/hotels in the tourist industry is a response to careful analysis of the political, social and economic reality of the Mediterranean area, and the accepted principle of sustainable development both in socio-economic and environmental terms. The decision of the European Parliament and Council concerning the five-year plan from 2002 to 2006 relating to Community Actions for Technological Research, Development and Demonstration is the framework for the research. The five-year plan 2002/2006 is the focus for the development within the European Union of the economy and a society based on knowledge, a key factor in innovation, for competitiveness, employment, sustainable growth and social cohesion. To reach this objective, technology must be designed, developed and distributed, which is able to ensure a more rational use of natural resources, reduced production of waste and less impact of economic activities on the environment.

Simultaneously the Sixth Action Plan For The Environment in the European Union 'Environment 2010: Our Future, Our Choice' underlines a number of no less relevant factors. One of the main aims identified in the document is the need for a quality environment in which the quantity of contaminants of anthropic origin has reduced impact and is not a significant risk to human health, and another is the need to ensure that the consumption of renewable and non-renewable resources does not exceed the capacity of the environment to absorb waste; these aims should be accompanied by a reduction in the consumption of

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resources enabled by improved efficiency in consumption, an increasingly 'intangible' economy and the prevention of waste. With the increase in wealth and productivity in a society such as ours, the demand for products increases; together with the fact that product life cycles are much shorter; the consequence is an increase in waste, obsolete products, mined out quarries and production plants that have no longer any function. Systems for studying environmental performance, with LCA methods for the various components that go to make up a building, are increasingly needed. Amongst these our attention has focused on those facing this evaluation from the life cycle approach for three different reasons:

- the fact that the life cycle assessment method is scientific was recently (1998) standardized by a series of international norms (ISO 14040) and used by the European Community as an evaluation tool for issuing environmental labels and certificates on products and processes (EC 1980/2000 rule, ISO TR 14025; EC 1836/93 rule);
- the kind of output of such a method allows us to obtain quantitative evaluations through a transparent and verifiable process, which is different from methods that propose an output of the qualitative kind often based on subjective evaluations; moreover, a life cycle approach allows product environmental controls between its life phases.
- the competence accumulated over the past few years, by some work groups involved in the research, in applying the LCA.

This means not only creating databases for the environmental performance of materials, the technological plant, the quality of life indoors and orientation, but also creating effective means for measuring the overall impact of a building. Within this framework the instruments developed internationally and by the member states of the European Union for controlling the impact of buildings throughout their life cycle are of fundamental importance.

The potentials and limits of LCA have made it possible to carry out research including the application of these methods to the building process.

METHODS

The aim of our specific research is to create a method of environmental assessment for building materials based on a life cycle approach.

The environmental sustainability of buildings, in fact, is not a question simply of the efficient use of plant and/or the study of passive climatic systems but is related, above all, to the use of materials and building techniques which are highly compatible with the environment, both in terms of the energy required for their production and the costs of transportation, installation and final demolition. This approach is radically different from the conventional idea of environmental impact as related merely to the production of materials, and includes the entire life cycle of the product or component. An approach based on the environmental impact of building materials is essentially based on the overall analysis of environmental impact or Life Cycle Analysis (LCA), including production, processing, installation and demolition.

This method differs from other environmental instruments in a number of significant ways:

- it can be used to study the environmental impact of a product or function for which the product is used;
- it produces objective data by means of a transparent process;
- it can be used to control that the environmental impact of each phase is not translated to another phase of the product life cycle.

The information which can be obtained from LCA, associated with information relating to other aspects such as costs, convenience and the safety of the consumer, can be used to take decisions concerning the development, improvement and manufacture of a product, to develop policies aimed at both producers and consumers, and (our own aim) to provide environmental

guidelines for the use of services and products. Let us imagine, for example, the use of LCA to provide designers in the building industry and architects with forecasts of the environmental performance of the buildings they are thinking of creating: the instrument would be of vital importance in their decision-making process.

The specific objective is, therefore, to create a database for building materials which can be used to help designers and architects to create environmentally sustainable touristic and receptive facilities in rural Mediterranean areas. Currently, no instrument of this kind exists in Italy.

The general lack of environmental certification in Europe (ECOLABEL) has prevented technicians from obtaining environmental impact statistics for comparable products (the only group of products in the building industry which has established ecological criteria for European certification is paints for interior design—about 90 products have been certified, most of them Swedish).

Moreover, many criteria and ecological trade-marks have been developed at the international level and recently at the national level in order to guarantee environmental quality for tourist-receptive structures. Pending action by the European Union, aimed at reinforcing and redirecting environmental policy concerning products and for the promotion of environmentally compatible products, based on the Integrated Product Policy (IPP) and the anticipated results of these actions, individual actions with the same aims should be harmonious (European Commission, Brussels, 07.02.2001, Green Paper on Integrated Policy Relating to Products). In line with this objective, and to define the methods for the environmental assessment of building materials, the operational unit has focused its attention on the guidelines used for the 'Environmental Product Declaration' (EPD) drawn up by the environmental quality unit of ANPA, specifically: UNI EN ISO 14040; UNI EN ISO 14041; UNI EN ISO 14042; UNI EN ISO 14043.

This would mean, in the case of widespread use of the Environmental Product Declaration, that products could be inserted into the database with a ready-made environmental assessment of certified building materials, or if the EPD does not become widespread, the ability to use LCA carried out on building materials in the database in the process of product certification for similar materials. Hence, in relation to the aims of the co-ordination programme, this operational unit intends to develop a methodological instrument for the environmental analysis of building materials using a Life Cycle approach to identify and assess their environmental impact.

These aims have been scheduled into a number of different phases.

I Phase—Preliminary Investigation

This phase will include the analysis of software used for the environmental impact analysis of building materials as used abroad (with particular reference to the sections used for the selection of building materials), the analysis of databases for the 'environmental' selection of building materials and the analysis of eco-inventories, as well as LCA for building materials. The way the guidelines propose to apply LCA for the 'Environmental Product Declaration' of ANPA will also be studied.

The result expected for this phase is a thorough comparison of available methods of environmental impact assessment and a method for applying LCA to the EPD.

II Phase—Definition of Transferability Criteria of the Experimentations Selected in the Research Application

This phase, together with all research bodies, will proceed:

- to define the context in which the instrument will be developed (rural Mediterranean areas);

- to a close exchange with trade associations included in our operational unit (Italian Biological Agriculture Association, CTS 'Environment', Lega Ambiente), in order to verify the requirements of the main groups of end user.

Final results of the phase: transferability criteria of the experimentation selected in the research application (receptive tourist structures in rural Mediterranean areas) related to the selected case studies in the preliminary surveying phase and definition of the requirements for the reference final user.

III Phase—*Definition of the Methodology for Environmental Assessment*

This phase will include the determination of the method to be used for the application of LCA for the development of a database of building materials based on the Italian situation. Specifically, it will involve:

- identifying the limits of the system
- establishing how primary data can be used and whether other databases can be used to develop specific LCA in relation to building materials
- identifying a set of aggregate environmental impact indicators.

It is possible to synthetically represent the way LCA could be applied to building materials and test how its conventional four phases should be applied (to be verified in the course of the research project). Before this, the aim and scope of the application will be established; this phase will include identifying possible alternative materials for specific applications. The functional unit will be identified and the quantity of material required for the specific application will also be established.

The second step is the drawing up of an inventory using information from Italian databases and/or the use of primary data or LCA already developed for building materials.

In the assessment phase, data will be classified (i.e. aggregated into the specific classes of environmental impact which are normally used, such as: energy consumption, depletion of the ozone layer, etc.) and analysed (i.e. data will be made homogeneous in order to enable comparison between similar materials) and the most appropriate method for assessment will be established at this stage.

The next step will be to correlate the above results with the initial aims and scope of application. At the end of this set of activities we will begin to define the structure of the environmental database for building materials. The expected result for this phase is the development of the first version of an environmental impact assessment method for building materials used by hotels for tourism. The method will be tested and fine tuned during subsequent phases.

IV Phase—*Application of the Environmental Impact Assessment Method to Test Cases*

This phase is for method validation by means of the development of LCA for certain test cases. The database logic will be identified and implemented on the basis of the results of the test cases.

Two types of cases will be used (buffering by conventional method and with innovative technology) relating to characteristic building techniques for hotels in the Mediterranean region. Buffering is a fundamental feature of creating an internal climate, acting as a filter, barrier or interactive unit. The difference between conventional and innovative buffering leads to various differences in the analysis of environmental impact: in the case of conventional buffering each material must be analysed and then integrated, whilst in the case of innovative buffering the manufacturer's assessment of each component will be used.

The environmental database previously defined by the Information Technology operational unit (Bari), will be improved according to the out-coming results of this phase. The expected result of this phase is the application of LCA to test cases, (innovative versus innovative buffering) using the method developed in phase II. This will help validate and fine tune the method. The results will be kept in a database.

V Phase—Development and Implementation of an Evaluation System Model of Environmental Performance of Touristic and Receptive Facilities in Rural Mediterranean Areas

This phase will involve integrating the database for building materials with information from the other operational units (fine tuning of building design in relation to environmental impact—the assessment of pollution caused by the use of materials and/or plants—the satisfaction assessing element of the final user). A method for assessment of the entire building will be established, including all parameters (location, materials, plant) with scoring for each parameter and a multi-dimensional rating system for the overall impact. This phase will involve intense dialogue between operational units in order to co-ordinate parameters developed by each and create an overall assessment method. The expected result of this phase (for all units) is the Evaluation System Model of Environmental Performance of Touristic and Receptive Facilities in Rural Mediterranean Areas.

The Evaluation System Model of Environmental Performance of Touristic and Receptive Facilities in Rural Mediterranean Areas will be assessed by a close exchange with trade associations.

RESULTS

This method has been thought out more as a tool to help planning (for new constructions as well as for restoring and re-using existing buildings for new purposes) than as a means of subsequent evaluation.

Some possible users are:

- architectural or engineering planning offices;
- universities (as an educational means);
- category associations in different fields (tourist—hotel, plant installers, producers of building materials, etc.);
- local bodies and administrations, town hall technical offices, etc.

CONCLUSION AND IMPLICATIONS

In the field of research application, hotels in the Mediterranean are an important target, since the entire sector is growing fast and currently lacks proper environmental control. The basis of sustainable tourist development is a long-term plan for guaranteeing the profitability of the Mediterranean area aimed at ecological, social, cultural and economic sustainability. The international debate on the difficult relationship between the development of tourism and the safeguarding of the environment has recently been joined by a number of authoritative figures who, however, have often spoken in rather theoretical terms. The charter for sustainable tourism drawn up during the Lanzarote conference in 1995 is one of the fundamental policy documents; it contains 18 principals defining how tourism can be planned and carried out while at the same time safeguarding natural resources and the environmental heritage for the future. During the Rio conference, the International Community drew up Agenda XXI to sustain the work of the United Nations Commission on sustainable development, focusing on aspects of tourism such as: the impact on the environment and society, coastal areas, drinking water, contributions for nature parks and protected areas, the support of economic growth, etc. At the international level, the work of the last meeting of the CSD in New York in 1999 established 2002 as the year of *ecotourism*.

In parallel, at the community level, the strategies for interaction between tourism and the environment set out in the 5th Action Programme For The Environment And Sustainable Development, and still valid, include implementation and supervision of strict environmental regulations concerning noise, drinking water, bathing, waste water and atmospheric emissions; the creation of buffer zones around sensitive and environmentally fragile areas,

tough regulations for new buildings and the struggle against illegal new construction, as well as education and training for local communities and tourists. Specifically, within the framework of the proposal for the first 4-year programme for European tourism—‘*PHILOXENIA*’ (97-2000)—the commission laid the foundations for greater competitiveness and quality in European tourism.

In order to promote the objective of sustainable tourism, with particular attention to the quality of the environment, a number of initiatives and instruments in the community and internationally can be identified. They include Environmental Management Systems (EMAS, ISO 14000) and product certification (Ecolabel ISO 14040). around 150 companies in Italy have obtained ISO 14001 certification, with the first ISO 14001 environmental certificates being awarded to hotels recently. A new and important feature is the EMAS 2 procedure, which extends environmental certification to all economic activities, including tourism. In addition to European regulation 1980/2000, the European Parliament is planning to extend the application of the ecolabel to the service sector and the first service to be included, given its priority nature, will be tourism. Following the European initiative and on the basis of the importance of the tourist industry in the Mediterranean area, ANPA promoted a national study on the applicability of the European Ecolabel to the Italian tourist industry, which also involved identifying groups of products meeting national requirements. An analysis of the political framework shows that the European Community has an environmental tourism policy with identifiable aims, objectives and instruments. Public institutions and private enterprise must now show that they are able to provide and manage innovative services for tourism, a delicate and complex sector of the economy involving a wide variety of factors, for which integration into a system of sustainable development is not simple; but the success of entire areas and holiday resorts in the future depends on it. Due to its cultural and natural heritage, tourism has always been, and will continue to be, a vital part of the Italian economy. Integrated, strategic planning at the right levels, together with technical instruments for specific problems, can make an important contribution to the balanced and sustainable development of tourism in Italy. This is where the interest of the research project focuses on the development of instruments to assist enterprise in the tourism industry to assess environmental impact and performance not only in terms of the services they provide, but also in terms of the hotels used. This is an instrument, which at the moment is lacking and without which it is impossible to achieve the aim of overall quality in the tourist industry. Given the prospects, the importance of the sector for the economy and social life, and the need for the protection and safeguarding of the natural and cultural environment, Italy must prioritize the promotion of balanced and truly environmentally sustainable tourism.

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