

expected impacts of the project. It can be qualitative or quantitative. Qualitative checklists show the expected impacts in relation to several environmental aspects. Quantitative checklists use coefficients and formulae to assess the impact made upon the environment.¹⁴ Different types of checklists can be recognized, from purely descriptive to more quantitative in the identification of expected impacts.¹⁵ The limitations of a checklist approach are due to its generality, and for this reason it is employed when a full and in-depth analysis of impacts is not required. The types of project which can be assessed using the checklist technique are, for instance, those involving water resources, for example housing projects which might alter natural water habitats. Leone and Marini recommend the use of indices to describe the ecosystem situation before and after project implementation.¹⁶

The *matrix technique*, allowing cross-analysis between the activities of the projects and the environmental characteristics of the area where the project is to be implemented, includes the consideration of the cause and effect relationships. The differences between matrices are due to the quantity and quality of variables included in the matrices. The environmental characteristics are usually classified in three categories: physical and chemical features, biological characteristics and social variables. Matrices have been used to assess the environmental impacts produced by large scale projects such as airports or major urban regeneration schemes.

The *overlay technique* is a cartographic method. Several thematic maps are overlaid in order to describe the environmental quality of the area and to verify whether the project is compatible with the characteristics of the area. The techniques developed by McHarg can be included in this category.¹⁷ The basic procedure is based on the preparation of several maps, showing the environmental components which are expected to be affected by the development project. Each map is shaded according to the degree of impact caused by the project on

the environmental component considered. The shadow will range from the lightest tone to indicate no impact to the darkest tone for significant negative impacts. Then these maps will be superimposed showing the areas in the darkest tone as unsuitable for the proposed development. This technique has been further improved with the development of Geographical Information Systems (GIS), which allow the handling of a great deal of data. In addition, the use of GIS enables the construction of several hypothetical scenarios of development in a shorter time than doing it manually. The limits of this method are threefold. Firstly, it does not assess secondary impacts. Secondly, there is no distinction between reversible and irreversible impacts. Finally, it does not take account of whether the impact takes place or not. Despite these limitations, this technique is suitable in the case of new urban housing developments, for instance, to give information on the types of soils or the natural habitats affected by the development.

Methods of impact identification based upon the use of *networks* try to estimate project impacts using, as the starting point, the single actions which form the project. Each action generates direct, indirect and primary and secondary impacts, which this technique tries to depict. According to Glasson *et al.* this technique can only be used to nominally identify impacts, since it does not give insight into the magnitude or significance of impacts.¹⁸

Quantitative techniques are based on the production of indices to measure the changes caused by the project. The technique developed by the Batelle Columbus Laboratories identifies a score for each of the four components of the environmental impacts to be assessed, namely: ecology, environmental pollution, aesthetics and human interest. The aim is to assess through mathematical functions the changes induced by the project. If the new score is greater than the original one there is a negative impact.¹⁹

The important issue is which technique is relevant for urban design schemes. This question is

very much related to the nature of the project. A new housing development, an urban renewal scheme, or a transport-related project are assessed through the employment of different techniques. Not only is the choice of the technique determined by the nature of the project but also by the size of the project, whether a moderate- or a large-scale project, and last but not least, by time constraints in preparation of the assessment.

CASE STUDY: NOTTINGHAM LRT

The Nottingham Express Transit Project is a light-rail transportation project. The line links Nottingham City Centre and the northern part of the Nottingham conurbation.²⁰ The objective of the project was to serve the transport needs of the area without jeopardizing the equilibrium between environment and economy. The project was enclosed in Annex II of the 1988 Town and Country Planning Regulation on the assessment of environmental effects. However, a full environmental impact assessment was carried out because the preparation of such an assessment is required for all projects presented in Parliament. The project was granted Royal Assent in 1994, but the process itself started in 1988. It included the preparation of feasibility studies which examined several of the projects' features, such as engineering feasibility, cost, road congestion and the potential environmental impacts. Public participation was sought to define the Nottingham Express transit route. A checklist technique was used to carry out the assessment. The project impacts, assessed both at the construction and operation stage, were: transport and traffic, noise and vibration, land use and planning, contaminated land, spoil and waste, air quality, visual intrusion and landscape, community issues, water quality and ecology. Significant impacts on the environment at the construction stage were identified and a series of mitigation measures in terms of good construction practices were suggested. The study identified a

number of concerns. In particular, consideration was given to the implications of land-take of open space, the visual impact in areas of high scenic value, and noise and vibration in tranquil residential areas. The study found considerable scope for mitigating impacts through engineering solutions, changes to layout, modification to operating specifications, and by rigorous control of certain aspects of detail design. The study concluded that the positive beneficial effects outweighed the negative impacts which were reduced to a minimum by the mitigation measures. The environmental impact study was not concerned with secondary impacts because these were considered far beyond the scope of the environmental assessment. The Nottingham Express Transit Project has gone through the several steps of an environmental impact assessment process from screening to project approval. It would, however, be of use to carry out an *ex-post* assessment to evaluate the extent to which the environmental impact assessment was correct in predicting project impacts and in preventing irreversible damages to the environment.

PREDICTION OF ECONOMIC IMPACTS

To predict economic impacts, mathematical models can be employed.²¹ For instance, using several techniques based on regional multiplier theories, the effects that a new injection of investment produces on an economy can be predicted. Three types of analysis can be carried out: economic base analysis, regional multiplier analysis and an input-output analysis. These analyses are linked to three regional multiplier theories. These three main theories, namely, economic base theory, regional trade multipliers and input-output models, can be used to explain the income and employment effects in an economy owing to an exogenous change such as a financial investment. For instance, an urban regeneration project produces direct, indirect and induced economic impacts.