# Urban Life Cycle Analysis and the conservation of the urban fabric

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The application of Life Cycle Analysis to urban fragments is only relevant if situated within the larger conceptual framework of sustainable urban development. Furthermore, the traditional focus on environmental impacts has to be completed by taking into account the aspects of the long-term resource conservation of the urban fabric. The position paper develops these points and it is structured in 4 themes and 19 theses.

## Theme A: Sustainable urban development is the conceptual comprehensive framework

### 1. The principles of sustainable development

The principles of sustainable development are considered within the EU today as the guiding principle for policy actions in general (Aalborg Charter, 1994) and for particular actions in the realm of the built environment (EC-Expert group, 1996). This constitutes a considerable enlargement of the predominantly economic preoccupations, which characterised urban development and planning since the Second World War. The principles of sustainable development introduce the concept of time, taking into consideration the interests of present as well as of future generations. Current thinking about sustainable development considers simultaneously economic, environmental, social and cultural objectives in political decisions as well as in regional and urban planning. In SUIT (Sustainable development of Urban historical areas through active Integration within Towns – an EU Programme Environment and Sustainable Development, Key Action 4: The City of Tomorrow and Cultural Heritage), the principles of sustainable urban development are basic objectives, which guide the development of urban historical areas.

### 2. Policies and tools for the assessment of sustainable urban development

Policies, methods and tools are necessary to realise a transition to a sustainable urban development. These allow the sustainability protection objectives to be formalised and for the results to be assessed. Among different assessment methods, Life Cycle Analysis (LCA) has been considered particularly relevant because it has enlarged traditional system limits in space, time and in the number of concerned aspects. Life Cycle Analysis can be directly and structurally related to Life Cycle Costing as well as to other types of social and cultural impact assessment.

### 3. Urban metabolism

In recent EU work on sustainable cities (Aalborg Charter, 1994; EC-Expert group, 1996), cities are considered as complex urban systems which, in turn, creates significant analogies to ecosystems.

Ecosystem concepts are helpful for understanding the problems of urban sustainability and for choosing approaches to solving them. Cities can be described as a complex, physical ecosystem in a similar way to wetlands or forests. Techniques from empirical ecology can be applied to modelling cities in terms of flows of energy, nutrients, abiotic materials and the effects can be analysed on other physical ecosystems (such as the surrounding countryside). One refers to such a system description as "urban metabolism". The concepts of physical ecology can also be applied metaphorically to the social dimension of cities - to think of each city as a social ecosystem.

### 4. System limits, time horizon and urban flows

Ecosystems thinking emphasizes the city as a complex system characterized by continuous processes of change and development. Aspects such as energy, natural resources, transportation and waste can be regarded as flows or processes. The acts of maintaining, restoring, stimulating and closing cycles contribute to sustainable development. The measurement of system performance raises specific methodological problems, in particular concerning system limits, time horizons and functional units. Conceptually, it is necessary to know the full environmental consequences of each decision or action from 'cradle to grave' in order to evaluate different performance or compare options. The basic methods for this are Mass Flow Accounting (MFA), Life Cycle Analysis (LCA), Life Cycle Costing (LCC) and combinations of these methods. These constitute a basis for the estimation of the medium and long-term outcomes, in particular for the global economic consequences which include 'externalities'. The measurement of systems performance provides an improved basis for citizens' information and for political decisions.

### 5. Complex relations between objectives and indicators

In the assessment of sustainability, objectives and indicators are related in a complex way. Like other assessment methods, LCA establishes the relation between objectives and indicators where one objective can relate to several indicators and one indicator can be used to assess the fulfilment of several objectives. A new holistic approach becomes possible through the sharing of data between different assessment methods.

### 6. From impact related methods to resource oriented methods

Existing assessment methods (EIA, Risk Assessment, SEA, Cost-Benefit, LCA and LCC) are nearly exclusively impact related. The objective is to minimize the impact or cost of a product or service (LCA, LCC), project (EIA) or plan (SEA). Although the efficiency of all processes, products and plans can be improved, this is insufficient to meet sustainability objectives. Over the long-term, sufficiency and resource conservation become equally important criteria and need integration within all assessments.

## Theme B: Sustainable urban development as a new planning paradigm

### 7. From the preventative principle to the precautionary principle

As presently operationalised, EIA and SEA methods are primarily applied to minimize and mitigate, as far as possible, the non-desired, adverse effects of projects and plans. The EIA process is usually applied in accordance with the preventative principle rather than the precautionary principle. The preventative principle has the limited aim of avoiding reasonably known or predictable environmental

impacts and risks rather than maintaining natural, social or cultural capital under conditions of uncertainty (where outcomes cannot be predicted with confidence or assigned a probability of occurrence). It is not possible to realise the necessary extension of these methods without a new framework.

## 8. Outline of a common framework for several assessment methods

The necessary combination of several assessment methods can therefore only be realised by engaging with a common framework of objectives and by sharing common data describing the built environment. This integration allows for understanding and controlling the interdependencies between the different sustainability protection objectives and indicators of the present and future situations. Until now, assessment methods have been used independently and generally did not take into account longer time frames (in particular intergenerational and historical dimensions). Their focus was either on individual buildings or on regions. However, their focus did not include urban fragments that appear as planning projects today. The proposed integration of both objectives / indicators with the basic physical framework (flows) will constitute a new, more powerful basis for the management of the built environment (defined as the construction, operation, renovation and disposal of buildings, infrastructures and exterior surfaces).

## 9. Integrated Life Cycle Assessment

Life Cycle Analysis has been normalised by ISO and proceeds in 4 steps: (1) Goal and scope definition, (2) inventory of extraction and emissions, (3) impact assessment, (4) evaluation and interpretation. Time and space limits can be shared with other methods like MFA and LCC to allow the transfer and the aggregation of results. The built environment has to be described in an appropriate way to establish mass, energy, financial and information flows over specific periods, in many cases over the whole life span. LCC is similar from a methodological point of view to LCA except for the problems of discounting.

## 10. Common description of an urban fragment

To improve the applicability of LCA, the description of urban fragments requires integration with current professional tools like Geographic Information Systems (GIS), Computer Assisted Architectural Design (CAAD), Quantity Surveying and Simulation. The existing practice of separating the assessment in distinct parts along methodological lines has resulted from the diversity of concepts and data. This allowed complexity to be reduced by defining partial rules of quality and by excluding assessments that were not desired for political or economic reasons. The proposed integrated, sustainable approach is designed purposely to not separate conceptually or practically the different aspects. This is made possible through a common description of the urban fragment and the sharing of data.

## 11. Extension of knowledge improves planning expertise

The integration of comprehensive LCA methods and of general considerations of long-term resource conservation into SEA type procedures are a great opportunity to improve both democratic decision methods and professional planning expertise. A large number of investigation and documentation methods can be used simultaneously, combining system (ecosystem simulation), physical (engineering) and historical (textual and contextual) approaches and sources. The focus on the built environment is widened to consider how and why it was

designed, built, transformed, repaired or restored. Technical information is as important as the use of non-technical and fuzzy information, present information is as important as historic knowledge. Extending the scope of interest to constructive and building processes including the history of the building site and the general building production conditions offer an ideal bridge to engineering (technical) and economic history as well as to the conditions of use of buildings and the social and managerial aspects. The acquired knowledge from the investigation about the age and survival of materials, components and whole building ensembles constitutes a highly relevant link to understanding the past and future resource use.

# Theme C: Accounting for time in sustainable urban development and LCA

### 12. The importance of historic information for resource conservation

In the case of the European towns, it is necessary to engage historical information about the built environment in order to predict the long-term behaviour of the built environment. The integration of the mentioned tools needs specific properties of advanced spatial-temporal databases, such as GIS systems. A detailed social/historical description of the development of the existing built environment creates understanding and allows future actions to be quantified in order to maintain the resource value over a longer period. However supplementary exogenous aspects of the development (e.g. political decisions, changing planning paradigms etc.) as well as internal aspects (e.g. the change of utility networks, technical equipment, IT technologies, new materials etc.) limit extrapolations.

### 13. Historic information as the point of departure of simulations of the future

The information about the course of the historic development contributes to the simulation of future outcomes (base line, alternative outcomes). Historic information on both the urban fabric and the way it is used is also necessary to estimate the use-related social values (social capital) and the non-use related cultural values (immaterial values). This explains why parts of towns can develop along different speeds because of their particular character (religious buildings, very expensive and exclusive buildings or very large objects).

### 14. Consistent consideration of time

The consistent consideration of time is of great importance for establishing scenarios for possible future developments. In LCA, as well as in historical research, all data are time relevant. However, there are problems in dealing with historical, present and future time scales. Through simulations different periods can be linked. There are different simulation procedures:

• *Ex post:* The future development is simulated based on the past development (trend) to obtain information about the possible future behaviour of the system (building)

• *Ex ante:* The known past is simulated to appreciate (and validate) a model.

• *Fore-casting:* The future is simulated on the basis of the past to obtain the state of the system at a certain future moment (path given, result open)

• *Back casting:* The simulation seeks paths to reach a given value at a given moment in future (results given path open).

### 15. The importance of scenarios in scoping

The main difference between the present practice of EIA and partially of SEA is the emphasis on the evaluation phase of a project / plan which has been prepared by a third party. The methods range from simple checklists to complicated environmental impact simulation. In the SEA literature, a higher importance is associated in the scoping phase where the base line alternative (continuation of the status-quo) and alternative developments should be established and partially assessed (at least to judge if they should continue to be part of the procedure). The development of such scenarios can only be based on a relatively detailed knowledge of the present state as the result of a historical process. This process has physical, economic, social and cultural reasons and aspects. In particular, the refurbishment dynamic of the existing building stock is a highly determining factor for the volume and type of building activity over longer time periods.

## Theme D: The urban fabric as a resource

### 16. The urban fabric and outstanding objects

These considerations concern the urban fabric as a whole and do not only apply as such to outstanding objects (which are generally defined and protected as monuments). However, there are differences because of the one-of-a-kind character and the uniqueness of monuments that mean that they cannot be replicated. In terms of ecosystems, this would mean the disappearance of a species with no possible mitigation measures (which are possible for large parts of the built environment). In the domain of cultural heritage, there is an implicit social convention which defines the part of the built environment as necessary and cannot be renounced in order to maintain the transmission of cultural techniques as well as for the cultural memory of a society. This small part of the built environment (which is generally well below the 1 % limit) cannot be naturally reproduced; the disappearance can only be slowed down. The definition of this non-reproducible part of the built environment exists in all European societies and is under the responsibility of a group of experts. Their judgement can be overruled by political decisions (which have to be legitimised democratically). However, it is not possible to replace expert judgements in this domain by democratic participation methods or conflict management strategies.

### 17. The European town and regional expertise

The European built environment is the result of very different regional and local cultural techniques and building traditions. The expression of each European town's uniqueness is achieved through a high differentiation in small urban scales. The evaluation of its cultural significance depends largely on regional expertise (which is much less the case for the assessment of ecosystems). Furthermore the past losses (through war destruction, traffic planning, etc) inform highly different local appreciation of what amount (number, scope and scale) of objects require absolute protection. The protection of the urban fabric is of higher actuality now because of the acceleration of urban transformation due to the growing commodification process of historic environments. The rapid ongoing changes might also lead to a loss of longer time scales.

### 18. Physical and non-physical aspect of the urban fabric

The proposed extensions of LCA and other assessment methods to historic urban fragments must take into account the system limits of cultural signification and the necessary related methods to appreciate it. The SUIT project is certainly at the beginning of a longer

development. Its objective cannot be to close the debate by simplified procedures before a larger discussion has taken place. The urban fabric, with its unique characteristics embedded to each society, has a physical and non-physical character. It furthermore has a continuity that is both spatial and temporal. This continuity constitutes a basic value; it is a fundamental urban resource and must be protected. Protection signifies that the urban fabric is not static and that it is not the fabric itself that is to be protected (except particularly remarkable parts like monuments). Instead, protection is required to ensure sustainability through the continuity of development and the embedded social and physical understanding and values for the members of the urban society.

**19. The continuity of the urban fabric**

The built environment constitutes a physical, economic, social and cultural capital (resource), which generally exists in an integrated form. The notion of "urban fabric" is well suited to describe a continuity which has physical, spatial and cultural significance. The fabric is characterised by a high degree of differentiation as well as a high continuity. Problems arise when the elimination of physical parts of the fabric will gradually also tend to eliminate social and cultural aspects of the fabric even if the concerned objects are not outstanding monuments. There is no simple theoretical solution to this problem, it cannot be solved by democratic participation techniques (open to 'short-termism') and existing experts do not have the power or expertise to decide. There is a large realm of the public sphere where democratic discussion, scientific work, planning procedures, architectural and cultural productions impinge. In terms of long-term resource conservation, it is probably preferable to apply the precautionary principle as a basic principle in this discussion.

## Sources for basic definitions

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