Evaluation of complex resilience strategies for sustainable cities

Peter Nijkamp and **Adele Finco***
in association with **Alessandro Segale**

Abstract

This paper seeks to offer an analytical framework for assessing and evaluating response strategies of cities with a view to long-range sustainable development. A city is regarded here as a complex, multi-dimensional and evolutionary, geographical concentration which aims to ensure continuity under changing external and internal conditions. Such a resilience strategy may be seen as a basic condition for the achievement of urban sustainability.

The paper gives a concise overview of the current debate on sustainable city development, and places much emphasis on the need to define proper and measurable indicators. Then a multidimensional evaluation framework is proposed that is able to assess and judge urban resilience strategies. Next, some illustrative applications on two cities (the Italian city of Cremona and the Dutch city of Enkhuizen) are concisely presented. The paper is concluded with some retrospective and prospective remarks, with typological framework for classifying urban sustainability cases.

1. Setting the Scene: the City as a Dramatic Action[1]

The city is the home of man. It is the theatre of social cohesion and dialectics. It is the cradle of civilisation and the temple of cultural, economic, technological and scientific progress. In a modern network society (see Castells 1996) the city acts also as a nodal centre for both global and interlocal connectivity of flows (material and non-material). Particularly urban economics has made an important contribution to

* This paper is the product of a joint work but the second author has mainly been responsible for sections 3 and 4.

1) Quoted from Geddes in EF (1997).

our improved understanding of urban agglomeration advantages as the driving forces for city formation and city growth. Clearly, in a dynamic world the specific roles and functions of cities may change and lead to fluctuating performance patterns of cities depending on their competitive behaviour and policy response (see e.g. Blackman 1995, Burton 1998, Edwards 1997 and Pacione 1997). But such evolutionary patterns do not erode the overall position of cities as centripetal and centrifugal geographical concentration points in a complex space-economy.

Doomsday prophets have often argued that cites would necessarily go through a process of self-destruction beyond a critical size of population or economic activity, but surprisingly cities have shown a high degree of resilience in coping with the great many burdens resting on the city's shoulders. Clearly, scale economies may for a while be overshadowed by diseconomies (e.g., social instability, unrest, decline in business, criminality), but most cities have managed to continue their life. Even cities which were sometimes regarded as hopeless cases such as Pittsburgh or St. Louis have shown remarkable signs of recovery.

A major challenge to modern cities is the need to ensure economic, social and ecological sustainability now and in the medium and long-term future. Economies of scale may erode the quality of the urban living environment and the social stability base of cities, so that a well-tuned effort has to be made to reconcile environmental demands with economic goals of the city. This task is once more important in a dynamic network environment instigated by the ICT sector, through which a trend toward mega-cities may emerge (see Brotchie et al. 1999).

Since cities go world-wide through a process of rapid change, the question is how to ensure continuity in change; in other words, how to use the valuable elements from the past (e.g., culture, science, entrepreneurial spirit) as the basis for a promising future. This resilience behaviour does not come about automatically, but certainly requires an effective sustainable city policy.

2. Urban Sustainability: the Body Shop

The issue of sustainable development has become the dominant policy paradigm in the last part of the 20th century. It calls for attention and policy action regarding our current lifestyle with high resource depletion, decay of environmental quality and increasing socio-economic disparities. The 1992 UN Conference on Environment and Development (the Rio Conference) pinpointed several strategic policy needs and resulted in Agenda 21 which claimed inter alia: "*Human beings are at the centre of concern for sustainable development. They are entitled to a healthy and productive life in harmony with nature*".

It was increasingly realized however, that such an ambitious goal should be fulfilled in close cooperation with local stakeholders. This awareness has led to the formulation of the Local Agenda 21 (1997) where a plea is made for dedicated local actions that are needed to combine a reduction of environmental decay with an improvement of local socio-economic conditions.

The European version of Local Agenda 21 is coined the Charter of European Cites and Towns Towards Sustainability. It regards sustainability as a creative, balance-seeking process extending into all areas of local decision-making. It states that sustainable development helps cities and towns to base living patterns on the carrying capacity of nature, while seeking to achieve social justice, sustainable economies and environmental sustainability (see also Mega 1999).

Cities are in absolute terms huge consumers; for example, an average European city of one million inhabitants consumes on an average daily basis approx. 320,000 tonnes of water, 11,500 tonnes of fossil fuels and 2,000 tonnes of food. Urban sustainability strategies may then be helpful in increasing the urban efficiency in consumption and in reducing the negative externalities. Cities may use their historical creative potential to cope with such problems and to develop new opportunities based on learning principles, through which the city can reach a sustainable evolutionary pattern by deploying flexible resilience and adjustment strategies.

The implementation of such strategies needs of course a proper use of policy and achievement indicators. This is also recognized in Agenda 21, where it is claimed that: "*Indicators of sustainable development need to be developed to provide solid bases for decision making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems*". Such indicators would be measurable, comparable, transferable, informative, signalling (e.g., early warning systems) and acceptable for policy choices. Ideally, policy choices should be based on realistic information, while the relevant indicator would have to be geared towards urban sustainability policies.

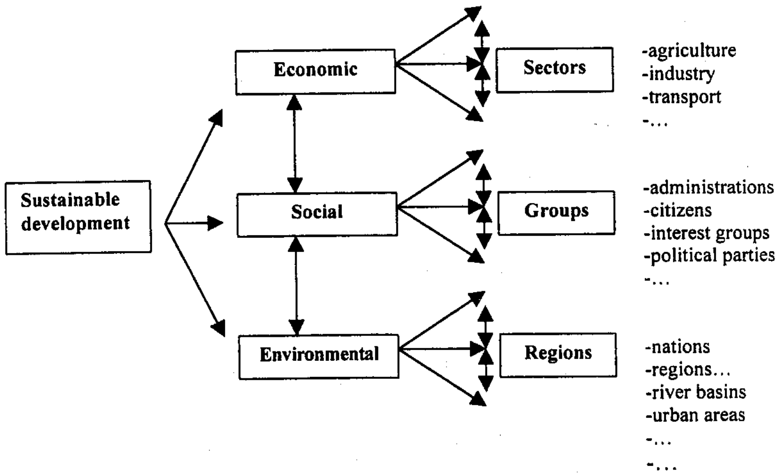
In reality, this is a complicated task, as the sustainability concept is a multi-faceted and often intangible notion which is characterized by fuzzy and conflicting elements. This is clearly reflected in land use planning where economic, social and ecological interests mirror a diverse portfolio of policy objectives (see Figure 1). We may refer here to the FAO (1993) description of land use planning: "*Land use planning is the systematic assessment of land and water potential, alternatives for land use and economic and social conditions in order to select and adapt the best land use options.*" Clearly, the most difficult question here is: what is best, i.e., from which perspective? This brings us into the realm of the rationality paradigm.

In the literature on planning theory we may distinguish several concepts of rational planning aiming at achieving the best possible outcome of decisions in the public sector:

- ***optimization***: this is a standard rationality paradigm which assumes an unambiguous objective function with clearly specified constraints and full information;
- ***satisficing behaviour***: this presupposes high transaction costs in achieving an optimal outcome (e.g., as a result of conflicting interests or incomplete information), so that a second-best solution may be found;
- ***multidimensional decision-making***: this idea takes for granted different actors or a set of different objectives leading to multidimensional trade-off issues among different choice possibilities (reflected e.g. in multiple criteria analysis), thus creating best compromise solutions;
- ***accountability***: in this view on planning the main task is to ensure a decision or policy outcome that can be justified in the light of prevailing regulations, procedures or established practice, without resorting explicitly to any optimality criterion.

In our approach we will opt for a multidimensional decision-making approach, as this is most flexible and in agreement with many practices that are governed by conflicting views or priorities. This approach can also be used for various levels of decision-making, such as strategic, tactic or executive.

Figure 1. Representation of strategic sustainable planning



Source: Beinat and Nijkamp (1998)

It is clear that the general concern on environmental decay causes much interest in negative environmental externalities, but it ought to be recognized that also various positive externalities may exist. For example, in a study on urban externalities Stanghellini and Stellin (1996) distinguished various types of externalities (see Table 1). In the same vein, also Camagni et al. (1998) developed a classification of both positive and negative externalities in the light of the need for developing sustainable cities (see Table 2).

Table 1. Externalities in the urban area

EFFECTS			EXTERNALITIES	
			POSITIVE	NEGATIVE
Technological	1.Source	Production	Integration of production sector	Emissions/pollution
		Consumption	Accessibility to environmental,cultural, architectural resources	Pollution Congestion
	2. Type of use	Private	System of waste (resources) recycled	Traffic pollution Waste
		Public	Environmental urban public goods (e.g. green areas)	Derelict areas
Monetary			Increasing value of suburban rural land	Increasing cost of basic resource scarcity

Source: Stanghellini and Stellin (1996)

It has been argued in Finco and Nijkamp (1999) that an environmentally sustainable development of a city can only be attained by initiating appropriate policy strategies. On this subject much literature can be found which focuses on the design of concepts or frameworks needed for such policies. It is clearly that initiatives in various cities world-wide differ strongly in the adoption and implementation of such concepts, because each city has its own specific geographical, political and environmental setting. Nevertheless, general integrative concepts and evaluation procedures may be developed which can serve as guidelines for many cities undertaking sustainability initiatives. A broad survey of such concepts can be found in Selman (1996), while an overview of policy strategies can be found in OECD (1995). Although it is likely that environmental quality problems may become more severe with urban size, there is no clear evidence that urban size as such causes environmental decay. According to Orishimo (1982) it is not the sheer city size, but rather the implied land use, the transport systems and the spatial layout of a city which are critical factors for urban environmental quality.

Policies addressing sustainable development of cities should, therefore, cover multiple fields like urban rehabilitation, urban land use, urban transport systems, urban energy management, urban architecture and conservation policy, and urban cultural policy. Measurable indicators including minimum performance levels and critical threshold levels will then have to be defined, estimated and used as forecasting tools so as to improve awareness of sustainable development issues of modern cities. Local authorities will have to share their tasks with all other actors in the urban space (including the private sector) in enforcing and maintaining these critical thresholds. It goes without saying that urban sustainable development is a process rife with conflicts and incompatibilities.

Table 2. Positive and Negative external effects of the interaction between different environments in a city

	Interaction between economic and physical environments	Interaction between economic and social environments	Interaction between social and physical environments
Positive external effects	Efficient energy use Efficient use of non renewable natural resources Economies of scale in the use of urban environmental amenities	Accessibility to qualified housing facilities Accessibility to qualified jobs Accessibility to social amenities Accessibility to education facilities Accessibility to health services Diversification of options	Green areas for social amenities Residential facilities in green areas Accessibility to urban environmental amenities
Negative external effects	Depletion of natural resources Intensive energy use Water pollution Air pollution Depletion of green areas *Traffic congestion* Noise	Forced suburbanisation due *to high urban rents* Social friction on the labour market New poverties	Urban health problems *Depletion of historical buildings* Loss in cultural heritage

Source: Camagni et al., 1998

Commitment to a strict environmentally sustainable urban development by key actors in a city is necessary for a successful implementation of sustainability policies. In doing so also economic (market-based) incentives are desirable in order to increase efficiency and to cope with the negative factors of modern city life. Failure to develop an effective balanced urban development policy will reinforce urban sprawl and will highlight inner city problems to a much larger area. Environmental-benign urban policies may, on the other hand, attract new investments, favour urban employment, and hence contribute to an increase in quality of life. The successfulness of such interventions depends clearly on three major background determinants:

- *institutional factors* (management and organization of the urban energy sector, public-private modes of cooperation etc.);
- *attitudes and behaviour of citizens* (life styles, mobility patterns, environmental awareness etc.);
- *urban structure and morphology* (population density, urban form, transportation networks etc.).

Local authorities have the possibility to exert both a direct and indirect influence on these determinants. The question whether a given urban development is sustainable or not is co-determined by the targets set by policy-makers. There is not a single unambiguous urban sustainability measure, but a multitude of quantifiable criteria which may be used in an empirical test. A necessary condition for implementing an effective planning system for urban environmental management geared towards maintaining sustainability is the development of a system of suitable urban environmental indicators (see OECD 1978). Such indicators, which should represent a balance between the necessary quality of information and the costs involved, would have to be related to economic, social, spatial and cultural dimensions of the city. The OECD has drawn up a long list of elements which are decisive for urban environmental quality and which would have to be included in such an indicator system. Examples are: housing, services and employment, ambient environment and nuisances, social and cultural concerns, etc. However, it appears to be extremely difficult to operationalize such an indicator system. This means that precise empirical evidence on urban environmental quality and on the implications for both household and firm behaviour is not always available or accessible.

3. Modern Cities in Search for Sustainable Regeneration

Living cities will go through fluctuating patterns of creative destruction. They need to revitalize and to innovate in order to survive in a competitive economic game, but they also need to maintain or restore their heritage from the past in order to remain attractive poles for residential and business purposes ('the liveable city'). This also means that cities would have to develop ecological innovations in order to reconcile conflicting interests (see Capello and Nijkamp 1999). Urban policy-makers tend to become increasingly change-managers seeking for innovative opportunities to regenerate city life. Their strategies are not based on blueprint planning concepts or fixed target approaches, but on adjustment and flexibility based on resilience principles from biology.

The evaluation of sustainable urban policies presupposes – as mentioned above – the identification and measurement of relevant indicators. An illustrative listing of such indicators can be found in the so-called Dobris Report (see Stanners and Bourdeau 1995).

In a more analytical way the OECD (1994) has developed the so-called PSR[2] (pressure-state-response), while the International Institute for the Urban Environment (IIUE 1995) and the Worl Resources Institut (WRI, 1995) have proposed the so-called ABC (area-basis-core) indicators list . Such approaches can be very helpful in identifying the driving forces of urban sustainability, while they may also be extremely helpful in pinpointing the relevant criteria to be considered in comparing alternative urban sustainability plans, e.g. by using multicriteria analysis.

In the past decade, many modern assessment methods have been in order to offer a methodological perspective for procedural types of decision-making in which various quality aspects are also incorporated. Many of these methods simultaneously investigate the impacts of policy strategies on a multitude of relevant criteria, partly monetary, partly non-monetary (including qualitative facets). They are often coined *multicriteria methods* and are also known as multi-assessment methods.

In order to reach a satisfactory policy in a complex environment, a careful process of decision-making is required which takes time and can be costly. The problems underlying a decision-making process in a spatial context may be subdivided into the following components:

- the information or data available always contain a component of uncertainty;
- the data or information may be stored in different data bases that may be difficult to access, manipulate, compare and study;
- a large set of - often conflicting - objectives or targets has to be taken into account;
- the decision-making process itself might be influenced by power relations or selfish motivations;
- a decision-making process has to take place within the shortest time possible to avoid countervailing effects.

This means that in any societal setting the best alternative or policy has to be determined which may boost public acceptability or

---

2) The PSR model has been changed by EEA (European Environment Agency) in DPSIR model (Driving forces, Pressures, States, Impacts, Repsonses).

at least social feasibility; in other words, the basic question is: what is the optimal policy? Theoretically, a decision-maker has to deal with an optimisation procedure, where from a set of alternatives the possible optimal choice is to be found, given the objectives and underlying conditions and constraints in real life.

Most decisions can be typified as being of a multiple objective or multicriteria type (Janssen 1992, Nijkamp et al. 1991, Beinat and Nijkamp 1998). This means that an optimal alternative from a set of alternatives is to be determined which best satisfies a number of - often conflicting - objectives. Another complicating factor is that on the policy level - besides a set of quantitative criteria - qualitative criteria also must be taken into account in a decision-making process. For our analysis of urban sustainability initiatives we will resort to multi-criteria analysis (MCA). In the next two sections we will give two illustrations of urban sustainability strategies from two cities, viz the Italian city of Cremona and the Dutch city of Enkhuizen.

4. An Illustrative Case Study on Cremona (Italy)

Cremona is a small to medium sized town (about 72,000 inhabitants) in the Lombardia Region (Northern-Italy) sited at the Po plain. Its economy is traditionally dominated by agricultural (especially dairy-farming) and agro-food sectors that have been gaining high productivity levels and a crucial role in the Po area. Furthermore, the town is characterised by a delayed but strong industrialisation process, that took place in the 60's and 70's. The Local Plan (PRG, the Piano Regolatore Generale), which is being developed together with the Provincial Territorial Plan, creates an important occasion to build a lively and attractive town. However, the Town Council still has to face the choice among different plan development options, which are all important but are also bound by the town budget restrictions.

The selection of the project alternatives has involved the main social actors and policy-makers (economic actors, such as unions, enterpreneurs, professional associations, social groups, etc.) according to a bottom-up strategy for achieving urban and territorial sustainability. A questionnaire was prepared in order to collect the choice options that each relevant group thinks are indispensable. Such projects were then tested and compared with the policy-makers' opinion.

In the original methodological approach there were 35 alternatives for future development of the city. They have been reduced in our case representation to 12 choice possibilities. This choice is typical of a strategic planning approach. The method of MCA allows also to make a cluster for land use policy. In the assessment matrix it is possible to have the most important alternatives envisaged. The selected project alternatives are all efficient from the point of view of an urban financial aspect. The project alternatives considered regard not only economic issues, but also environmental and social interventions that are indispensable for sustainable town planning (Table 3).

The selected criteria/indicators (35) comprise the economic, social and environmental aspects of the urban territory considered. The importance of the choice of indicators has already been discussed in the previous sections. The classification has been made by referring to the stratification of the three different constituents of urban and territorial sustainability, on the ground of standard international classifications. As Table 3 clearly shows, social and environmental indicators play a particular role according to international urban sustainability principles.

Weight assignment to criteria is fundamental in MCA, as the weighting vector represents the relative importance of each criterion. As a starting point, the various weights are often assumed to be equal. But in our study approach, three different weight tests have been applied (see Table 4):

(1) weights specified by the Cremona Town Council representatives, according to a 5-10 scale (weight set A);
(2) equal weights for all criteria (weight set B);
(3) weights defined by the experts according to a 10-point scale (weight set C)[3].

Our analysis will consider two MCA ranking methods: the weighed summation method and the concordance method. Their results will be compared for three different weight assignment options (weight sets A, B and C).

3) A 10-point scale also has been used for alternative scores during the matrix construction phase.

Table 3. MCA – impact matrix of the Cremona project

		Alternatives	1	2	3	4	5	6	7	8	9	10	11	12
											Derelict area			
		Criteria	Rural restructuring	Park project	System of waste recycling (incinerator eg.)	Street reconstruction-restructuring	Suburban commercial system	Parking system	Road system	Public transportation network	Center for elderly support	Cultural center. Conservatoire/Auditorium	University center	Congress center
1		Variation in GDP	6	8	7	8	10	6	8	7	9	10	9	9
2		Variation in employment	6	6	7	8	8	5	8	7	9	7	9	7
3	ECONOMIC	Integration of production sectors	7	9	6	7	8	7	9	9	6	6	8	9
4		Job mobility	7	7	7	7	8	6	7	7	8	8	7	7
5		Development SME	6	9	6	6	9	9	9	9	6	6	7	9
6		Commuting patterns	5	6	6	7	8	10	10	10	10	6	9	6
7		Administrative efficiency	6	10	9	6	7	9	9	9	9	9	9	9
8		Accessibility to education	6	2	6	2	2	10	9	10	6	9	10	10
9		Accessibility to sports facilities	7	1	10	5	1	8	8	8	7	1	7	2
10		Accessibility to welfare provisions	6	7	10	4	7	10	8	10	10	10	9	10
11		Accessibility to health service	1	10	2	2	1	7	9	7	10	4	4	4
12		Accessibility to post services	6	6	7	5	5	9	8	8	6	8	10	10
13		Availability bank services	7	5	7	6	8	8	8	5	7	8	8	9
14		Public security	6	9	5	2	4	8	7	8	7	5	3	5
15	SOCIAL	Housing quality	8	7	10	10	1	7	7	7	2	7	5	5
16		Quality of life	2	1	8	9	9	10	9	10	6	8	8	9
17		Population density	6	10	9	6	6	3	7	2	3	2	6	5
18		Ageing	2	9	7	6	9	10	9	10	6	7	9	7
19		Information systems	1	7	8	4	9	9	9	10	10	6	6	3
20		Cultural public relations	6	8	9	1	2	6	2	5	10	9	8	8
21		Racial Integration	7	2	6	8	4	7	6	6	7	10	10	10
22		Transport and traffic quality	6	1	5	4	8	6	3	8	5	9	9	9
23		Facilities for handicapped children	6	7	8	6	7	10	10	10	8	8	10	10
24		Civil participation	7	1	7	6	9	10	10	10	10	8	9	8
25		% of waste recycled	5	5	7	4	8	5	4	5	6	10	6	6
26		Quality of urban nature area	10	7	10	7	6	5	1	5	1	1	4	4
27		Energy consumption	7	7	6	5	7	5	7	7	5	4	5	7
28		Urban green areas per person	7	10	10	9	9	10	7	7	7	1	1	2
29		Landscape	10	8	10	7	7	4	6	4	6	6	6	6
30	Environmental	Air pollution	7	3	10	5	5	1	2	1	5	5	5	5
31		Water pollution	4	3	10	5	5	5	5	5	3	5	5	5
32		Soil pollution	4	3	10	5	4	4	3	3	5	5	5	5
33		Noise	7	4	10	5	4	1	1	2	6	4	5	5
34		Renewal rural areas	10	8	10	6	2	5	3	6	6	6	5	5
35		% derelict areas	7	7	7	5	5	5	5	5	8	8	9	8

Table 4. Criteria and weight system for the Cremona study

		CRITERIA	A*	B*	C*
1	ECONOMIC	Variation of GDP	10	1	7
2		Employment rate	10	1	10
3		Integration of product sector	8	1	4
4		Employment mobility	9	1	2
5		Development small enterprises (PMI)	8	1	8
6	SOCIAL	Commuting patterns	9	1	2
7		Efficiency of administration	8	1	4
8		Education	8	1	7
9		Accessibility to sporting equipment	8	1	5
10		Accessibility welfare work	7	1	6
11		Accessibility Sanitary service	8	1	8
12		Accessibility Post service	8	1	3
13		Availability Bank services	7	1	3
14		Public security	8	1	8
15		Housing quality	8	1	5
16		Quality of life	7	1	10
17		Population density	8	1	1
18		Ageing	9	1	5
19		Information systems	9	1	1
20		Cultural public relations	7	1	3
21		Racial Integration	8	1	7
22		Transport and traffic quality	7	1	8
23		Handicap/child facilities	9	1	10
24		Citizens partecipation	8	1	4
25	ENVIRONMENTAL	% of waste recycled	7	1	5
26		Quality of urban wildlife	5	1	4
27		Energy consumption	7	1	5
28		Urban green areas per person	7	1	10
29		Landscape	7	1	4
30		Air pollution	9	1	10
31		Water pollution	9	1	10
32		Soil pollution	9	1	10
33		Noise	9	1	4
34		Recovery of agricultural land	5	1	4
35		% derelict areas	7	1	2

Legend: Ordinal numbers are to be interpreted as: "The higher the better"

* A: weight specified by the Cremona Town Council according to a 5-10 scale

B: weights=1

C: weights defined by the experts according to a 10 point scale

The results of the rankings from the two alternative evaluation methods are shown in Tables 5 and 6. The weighted summation ranking (Table 5) does not present essential differences among the A, B and C options, at least for the first positions. The first selected alternative is the Park Project implementation (alternative 2) for each of the weights assigned to the objectives. The University Centre and the Meeting Centre (alternatives 11 and 12) are in the second and the third position respectively. The other positions are assumed by public transport, road system and parking strengthening projects (alternatives 8, 7 and 6) with some slight differences among the A, B and C options of the weight sets. Considering in particular the policy-makers' weights, public transport turns out to be more urgent than the other two alternatives, given the present inadequacy in both the urban and the extra-urban context. These interventions are clearly important not only for the community, but they are also an essential condition for a greater efficiency and dynamism of productive and commercial sectors of the city. The project alternative concerning social services development through building of retirement homes, is likely to be a good choice as well, as it regards an alternative use of abandoned areas.

Generally speaking, such areas are abundantly available and occupy a wide surface of the urban territory (university area, meeting centre, social services) and their recovery can produce various significant advantages in the urban social, environmental and productive context.

Analogously, in the concordance index ranking (Table 6) the position of the first four choices is the same as in the previous ranking (weighted sum), with very slight variations in relation to the different weight assignments to criteria.

As to the concordance index analysis, representing the total importance of the objectives for which an alternative is dominating the others, the "University Centre" is the greatest success alternative, showing a score of 1.9 (Table 7).

The study results encourage also projects concerning territorial marketing and the services sector. The model constructed suggests also some strategic choices for urban development, that can be further considered in a subsequent phase.

ALTERNATIVES	1	2	3	4	5	6	7	8	Derelict Area			
									9	10	11	12
	Rural restructuring (agritourism etc.)	Park project	Systems of waste recycling (incinerator)	Street furniture/ restructuring built	Suburban Commercial System	Parking system	Road system	Public transportation network	Buildings eldery People	Cultural Centre Conservatoire/ Auditorium	University Centre	Meeting Centre
weight A	11	1	10	12	9	7	5	4	6	8	2	3
weight B	11	1	10	12	9	6	5	4	7	8	2	3
weight C	11	1	10	12	9	8	4	5	6	7	2	3

Table 5. Results according to three weighted sets

ALTERNATIVES	1	2	3	4	5	6	7	8	Derelict Area			
									9	10	11	12
	Rural restructuring (agritourism etc.)	Park project	Systems of waste recycling (incinerator)	Street furniture/ restructuring built	Suburban Commercial System	Parking system	Road system	Public transportation network	Buildings eldery People	Cultural Centre Conservatoire/ Auditorium	University Centre	Meeting Centre
weight A	11	2	10	12	9	7	6	8	5	8	1	3
weight B	11	1	10	12	9	6	7	4	5	8	2	3
weight C	11	1	10	12	9	8	7	5	4	6	2	3

Table 6. Results according to concordance test

ALTERNATIVES	1	2	3	4	5	6	7	8	Derelict Area			
									9	10	11	12
	Rural restructuring (agritourism etc.)	Park project	Systems of waste recycling (incinerator)	Street furniture/ restructuring built	Suburban Commercial system	Parking system	Road system	Public transportation network	Buildings eldery People	Cultural Centre Conservatoire/ Auditorium	University Centre	Meeting Centre
weight A	-	1,6	-	-	-	0,3	0,7	0,9	0,8	-	1,9	1,4
weight B	-	1,8	-	-	-	0,4	0,3	0,8	0,5	-	1,6	1,4
weight C	-	2,4	-	-	-	-	0,9	0,1	0,5	0,9	2,1	1,7

Table 7. Concordance Index

5. An Illustrative Case Study on Enkhuizen (The Netherlands)

This case study concerns the city of Enkhuizen (in the province of North-Holland in The Netherlands). The city houses an interesting museum on the history of the interior lake, the Ijssel Lake, of The Netherlands. Plans have been made to extend the museum area towards an outdoor exhibition in order to attract more tourists and to reinforce the economic base of the city. The construction and opening of a new exterior part of this museum requires sufficient parking facilities for private cars in a densely built old city.

The city itself is an extremely interesting old place characterized by an impressive architectural and historico-cultural heritage which deserves strict protection, so that parking policy in this city does not only have a transport aspect but also a conservation aspect. The city is also a centre of tourism, with a strong orientation towards water sports.

In view of many conflicting issues, an exploration of all possible relevant locations for a sufficiently large parking lot, which would favour visits to the museum and the old city without being in conflict with the historical value of the place itself, can be made by using multicriteria analysis (see Munda and Nijkamp 1997). After careful exploration and public debate, seven alternative locations were taken into consideration:

(1) a location near a former cement factory in the city;
(2) a location on a camping site next to the museum;
(3) a location on a camping site in a recreation area;
(4) a more distant location next to a cemetry;
(5) an extra-urban location;
(6) a semi-extra urban location;
(7) a location near the sluices of a new dike (annex provincial road).

A major problem is not only formed by the land use needed and the site of the parking lot, but also by various routes that can be chosen by tourists to reach a particular parking lot. This may vary for each distinct alternative, so that a given location can be subdivided into some variants. The total number of meaningful choice options appears to be 15 in this case.

Eight evaluation criteria can be used:

(1) a maximum number of visitors, arriving by cars and buses, to the museum should use the parking lot;

(2) the parking lot should be as close as possible to the museum;
(3) the parking lot should have a good accessibility;
(4) the construction costs of the parking facilities should be as low as possible;
(5) there should be a minimal disturbance of the quality of life;
(6) the architectural land and the historical character of the city should be strictly protected;
(7) recreational functions should not be disturbed by the parking facilities;
(8) the loss of the remaining functions of the area to be used for parking should be minimized.

Clearly, these criteria are partly qualitative and partly quantitative in nature. The qualitative criterion scores, e.g. accessibility, disturbance of life etc., can be represented by either ordinal numbers or by linguistic variables; thus the application of one of the above described qualitative MCA methods is meaningful.

A closer investigation of the outcome of all choice alternatives with respect to all relevant judgement criteria has next led to the assessment of a complete (8x15) impact matrix. This matrix can be found in Table 8 (see also Blaas and Nijkamp 1995).

Table 8. MCA impact matrix of alternative locations of urban parking facilities

	Alternatives														
Criteria	1a	1b	2a	2b	3a	3b	3c	3d	4a	4b	4c	4d	5	6	7
1	6.5	6.5	15	15	10	10	10	10	3.5	3.5	3.5	3.5	15	13	1
2	12.5	12.5	14.5	14.5	9	9	9	9	4.5	4.5	4.5	4.5	1.5	1.5	16
3	4	5	2.5	6	11.5	2.5	11.5	7	9.5	8	13.5	1	13.5	1.5	16
4	14.5	14.5	10.5	10.5	5.5	13	3	4	2	10.5	5.5	10.5	7.5	7.5	16
5	1	10	3	10	10	3	10	10	10	10	10	3	10	10	16
6	7.5	13.5	7.5	13.5	2.5	2.5	7.5	7.5	13.5	13.5	7.5	7.5	7.5	1	16
7	14.5	7.5	4	1	10	9	6	2.5	11	7.5	12	2.5	13	14.5	16
8	14.5	14.5	1.5	1.5	5	5	5	5	10.5	10.5	10.5	10.5	10.5	10.5	16

The numbers in this matrix are measured in rank orders (including ties). A first inspection of this table teaches us already at the outset that alternative 7 scores in most cases as the best choice. Thus based on a visual inspection (e.g., a dominance analysis), we find immediately a conclusion. The dominance of the extra-urban parking lot near the new dike is only less strong, if criterion 1 would be assigned an extremely high value. These findings are confirmed by applying an MCA Regime method. This sophisticated concordance analysis applied with varying weights (including the above mentioned extreme cases) led to the conclusion that – also in extreme cases - alternative 7 has to be regarded as the best compromise choice. It is interesting to note that this alternative was also the choice option actually selected and implemented by the city. In retrospect, it is noteworthy that the city has chosen as the best compromise solution the alternative 7. This alternative appears to be almost dominant, given the ordinal criterion scores (only criterion 1 conflicts).

6. Towards a new typology

The principle of resilience means that cities are not passive victims, but have to show flexibility by adjusting their sustainability policies to challenges and opportunities. Consequently, they have to identify, explore and select choice options which –despite their complex and conflicting multidimensionality- ensure a balanced development under changing external conditions. The policy strategies supporting or enhancing urban sustainability may be varied in nature; they may range from the introduction of advanced environmental technologies or market incentives to strict land use and zoning policies or information campaigns. In general, a portfolio of different possibilities seems to be the best guarantee for sustainable urban development in a situation of drastic change.

A final question to be addressed in which generalizable or transferable lessons may be derived from an limited experiments on only a few cities. The problem is that the range of choice for a sustainable urban policy is vast, so that essentially a comparative case study research based on multiple experiments would be needed. This is a task for beyond the scope of this paper, but it is possible to offer as the end of this paper a typological framework through which individual sustainability strategies for cities can be assessed.

This urban sustainability typology will be based on three complementary angle, which will successively be described by a decomposition analysis. These angles are:

- strong versus weak (un) sustainable development;
- absolute versus relative (de)coupling (or (de)linking);
- local versus supra-local sustainability (the issue of *ecological footprints*).

First, the distinction between weak and strong sustainability will be addressed. The traditional viewpoint an strong and weak sustainability refers to the question whether substitution between different sustainability constituents is allowed for. If all sustainability components (e.g. natural capital, air quality etc.) are having a positive development sign, then we speak about strong sustainability . If some of them have a negative sign, but if the overall aggregate is still having a net positive sign, the situation is called weak sustainable. In on case, we will make a more precise distinction. We will denote the relative change in economic performance of a city by **E** and the relative change in ecological performance by **M**. Assuming that urban welfare is composed of economic and ecological performance measures, we may make the following classification for the relative change in urban welfare (**W**):

- strong sustainability (ss): **W**= **E** + **M** >0 with E>0 and **M**>0
- weak sustainability (ws): **W**= **E** + **M** >0 with E>0 and **M**<0 or E<0 and **M**>0
- weak unsustainability (wu): **W**= **E** + **M** <0 with E>0 and **M**<0 or E<0 and **M**>0
- strong unsustainability (su): **W**= **M** + **M**<0 with **E**<0 and **M**<0

These possibilities can also be classified in the following table (Table 9):

Table 9. A classification table for types of (un)sustainable development

	M>0	M<0
E>0	ss:W>0	ws: W>0 wu: W<0
E<0	ws: W>0 wu: W<0	su: WU<0

It is clear that an aggregate performance measure for **M** and **E** is not always very realistic. The ecology comprises many biotic and abiotic systems, which may change rather independently from each other. In many cases urban policy makers are facing a choice situation with substitution (or compensation) between different components of the urban ecology.

The same may apply the urban economic system. We may subdivide the urban economy and ecology in two distinct subsystems, indicated by $\mathbf{E_1}$ and $\mathbf{E_2}$, and $\mathbf{M_1}$ and $\mathbf{M_2}$ respectively. This means that we can now extend the typology in table 9 by considering also intra-economic and intra-ecological sustainable development. This may be illustrated by the following "sustainability tree" for the urban ecology:

M>0 — $M_1>0$ and $M_2>0$ ⟶ strong ecological sustainability
M>0 — $M_1>0$ and $M_2<0$ ⟶ weak ecological sustainability
M>0 — $M_1<0$ and $M_2>0$ ⟶ weak ecological sustainability

The next issues to be addressed in the context of urban sustainable development in the distinction between absolute and relative (de) coupling or (de) linking . This issue has generated much debate in the recent environmental literature in the context of the so called Kuznets-curve. The question as take here is whether the link between economic growth and environmental quality is in the long-run positive or negative. Relative decoupling means that this link is less than proportional, while absolute decoupling means that more growth may lead to environmental improvement. This can also be incorporated in the typology of table 10, where absolute decoupling (AD) means: **E**>0 and **M**>0 (i.e. the left upper quadrant).The same applies to the **ws** and **wu** case (in the left lower quadrant). The case of relative decoupling (RD) means that -1<M/E<0, which is a special case of the right hand side of table 9. Hence we get now the following table integrating sustainable development cases with decoupling cases, where the right hand column represents the coupling or linking case.

Table 10. A classification table for types of (de)coupling

	M>0	-1<M/E<0	M/E< -1
E>0	AD	RD	C
E<0	AD	RD	C

Finally, we will concisely address the spatial demarcation in terms of local versus supra-local sustainable development. This issue has mainly been instigated by the *ecological footprint* discussion. The main idea is that a city may be able to achieve a sustainable development (strong or weak), but that this achievement may be detrimental for its surroundings or for other regions. This means that the issue of urban sustainable development may be cost in a much broader spatial context.

For example, by making a distinction between the city **c** and the surrounding region **r**, we may create an enlarged table for the types of (un)sustainable development (see table 11).

Table 11. A classification table for typer of (un)sustainable development in case of ecological footprint of the city.

	Mc >0	Mc <0	Mr >0	Mr <0
Ec >0				
Ec <0				
Er >0				
Er <0				

Riferimenti bibliografici

Beinat, E., and P. Nijkamp (eds.), *Multicriteria Analysis for Land-Use Management*, Kluwer, Dordrecht, 1998.

Blackman, T., *Urban Policy in Practice*, MacMillan, London, 1995.

Brotchie, J., P. Newton, P. Hall and J. Dickey (eds.), *East-West Perspective on 21st Century Urban Development*, Ashgate, Alderhot, UK, 1999.

Burton, P., Urban Policy and the Myth of Progress, *Policy and Politics*, vol.25, no.4, 1998, pp.421-436.

Camagni, R., R. Capello and P. Nijkamp, Towards Sustainable City Policy: An Economy-Environmental-Technology Nexus, *Ecological Economics*, vol. 24, no. 1, 1998, pp. 103-118.

Capello, R., and P. Nijkamp, *Sustainable Cities and Energy Policy*, Springer-Verlag, Berlin, 1999.

Castells, M., *The Rise of the Network Society*, Blackwell, Malden, UK, 1996.

Colorni A., E. Laniado, and F. Rosace, *VISPA: Valutazione Integrata per la Scelta di Progetti Alternativi*, CLUP, Milano, 1988.

Edwards, J., Urban Policy, *Urban Studies*, vol.34, 1997, pp.825-843.

EF (European Foundation for the Improvement of Living and Working Conditions), *Utopias and Realities of Urban Sustainable Development*, Dublin, 1997.

FAO, *Directives pour la Planification de l'Utilisation des Terres*, Rome, 1993.

Finco, A., and P. Nijkamp, Evaluation of Sustainable Urban Development: Issues and Application, *Research Paper*, Dept. of Spatial Economics, Free University, Amsterdam, 1999.

IIUE, *The ABC Approach*, Delft, 1995.

Janssen, R., *Multiple Decision Support for Environmental Problems*, Kluwer, Dordrecht, 1992.

Mega, V., Planning the Civilization of Sustainability, *Paper International Conference on 'Sustainable Development and Spatial Planning in the European Territory'*, Athens, May 1999.

Munda, G., and P.Nijkamp, Urban Sustainable Development, ***Lo Sviluppo Sostenibile delle Aree*** *Metropolitane*, Ce.S.E.T., Napoli, 1994, pp.227-251.

Nijkamp, P., and E. Blaas, *Impact Assessment and Evaluation in Transportation Planning*, Kluwer, Dordrecht, 1995.

Nijkamp, P., and G. Munda, Urban Sustainable Development, *Lo Sviluppo Sostenibile delle Aree Metropolitane*, Ce.S.E.T., Napoli, 1997, pp. 227-253.

Nijkamp, P., P. Rietveld and H. Voogd, *Multicriteria Analysis for Land Use*

Planning, Elsevier, Amsterdam, 1991.

OECD, *Urban Environmental Indicators*, Paris, 1978.

OECD, *Environmental Indicators*, Paris, 1994.

OECD, *Urban Energy Handbook*, Paris, 1995.

Orishimo, *Urbanisation and Environmental Quality*, Kluwer, Dordrecht, 1982.

Pacione, M.(ed.), *Britain's Cities*, Routledge, London, 1997.

Segale A., 1993, L'uso degli indicatori ambientali, *L'impatto dell'agrotecnologie nel bacino del Po*, C.N.R.-RAISA - Franco Angeli - Milano, pag. 59.

Segale A. e Pareglio S., 1990, L'analisi multicriteri nella valutazione di impatto ambientale, *"Agricoltura"* n.204/205.

Stellin G., and S. Stanghellini, *Politiche di Riqualificazione delle Aree Metropolitane: domanda di valutazione e contributo delle discipline Economico-Estimative,* Atti del Convegno XXVI Ce.S.E.T., Milano, 17-18 ottobre 1996.

Stanners, D., and Ph. Bourdeau (eds.), *Europe's Environment* (The Dobrìs Report), European Environmental Agency, Brussels, 1995.

WRI, *Environmental Indicators*, Washington D.C., 1995.