Urban impact analysis in a spatial context: methodology and case study

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URBAN IMPACT ANALYSIS IN A SPATIAL CONTEXT :

METHODOLOGY AND CASE STUDY

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Abstract

URBAN IMPACT ANALYSIS IN A SPATIAL CONTEXT :
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Peter Nijkamp.

The paper is composed of two parts. The first part gives a methodological framework for urban impact analysis based on a systems-theoretic approach. This framework serves an an operational tool for including, describing and integrating various kinds of impacts of non-urban policies in an urban setting. The use of impact profiles and policy scenario's will be suggested as a synthesizing structure for developing urban impact analysis within the Dutch planning context regarding urban and regional developments. The relevance of this approach in a specific policy context based on a stepwise integrated impact system will also be explained.

The ideas laid down in the paper will be illustrated by means of an ex-ante analysis of the impacts of a regional employment and spatial-economic development policy for the city of Gouda in the region Midden-Holland in the Western part of the Netherlands. Four policy scenario's will be described in order to investigate whether - on the basis of available urban and regional research reports - the impacts of non-urban policies can be assessed.

The impacts being studied are inter alia the housing market, infra-structure, employment and quality of life. The paper concludes with a set of conclusions and evaluations.

Part A

METHODOLOGY

1. Introduction

In the seventies several kinds of impact analyses for planning and policy purposes have been developed: environmental impact analysis, social impact analysis, technological impact analysis, and so on. The main aim of impact analyses was to get a more complete, systematic and comprehensive picture of the effects of public policy decisions or of exogenous shifts in the parameters or data of a system. This is also the background of the current interest in urban impact analysis. Urban impact analysis will be defined here as a method for assessing the foreseeable and expected consequences of a change in one or more exogenous stimuli that exert effects on the urban welfare profile (see Nijkamp, 1981).

The need for urban impact analysis stems from different sources:

- a systematic inventory of consequences of public policy may lead to more justified regional and urban policy decisions.
- an integrated impact analysis may avoid the neglect of (potentially important) indirect or unintended effects.
- the presence of spatial spillovers and interactions between several spatial compartments requires a comprehensive view of the complicated mechanism of a spatial system.
- the hierarchical structure of national, regional and urban policy authorities evokes the need for a multi-level impact analysis which is able to trace all relevant consequences at various levels, especially because of the increasing role of federal and other government policies on the urban system.
- in addition to spatial impacts, a meaningful policy analysis also requires a consideration of spatio-temporal impacts due to dynamic and spatial feed-back relationships between the components of the system at hand.

As a whole, one may conclude that urban impact analysis aims at providing an integral - rather than a partial - approach to regional and urban policy analysis. The following two sections will be devoted respectively to some further remarks on impact analysis in general and on urban impact analysis in particular.

2. Impact Analysis : General

Due to the pluriformity and complexity of western industrialized countries, coherent and balanced public policy strategies are usually fraught with difficulties. For instance, the integration and co-ordination of various aspects of physical-economic planning problems (such as public facilities, communication and infrastructure networks, residential housing programmes, industrialization programmes etc.) is often hampered due to administrative frictions, mono-disciplinary approaches, lack of information and political discrepancies.

An impact analysis may be a meaningful tool for more integrated and co-ordinated planning strategies, as such an analysis describes systematically the effects of changes in control variables on all other components of a system (see Nijkamp, 1979). Consequently, an impact analysis should pay attention to the variety, coherence and institutional framework of the system at hand. This implies that economic, spatial, social and environmental variables should be included as relevant components of the system. Preferably, an impact analysis should be based on a formal model.

The grouping of a variety of variables in an impact analysis may be based on similarities in effects (cf. Friedrich and Wonnemann, 1981). Examples of such effects are: changes in spatial accessibility, changes in urban residential climate, changes in social structures, changes in urban employment attractiveness, etc. Such responses may emerge from several stimuli (changes in control variables), such as: urban housing programmes, energy conservation programmes, construction of an infrastructure network, etc.

Formally, the relationships between policy controls and the related impacts may be represented by a (qualitative or quantitative) model that reflects the structure of the system at hand. In this way, also all indirect and multiplier effects can be taken into account (cf. Nesher and Schinnar, 1981).

Given the pluriformity and variety among the elements of most social systems, a multidimensional profile approach is often a meaningful analytical method for considering systematically a wide variety of different aspects in such systems. This approach implies that a certain phenomenon in the system at hand is characterized by a vector profile with a set of different (multi-dimensional) components or attributes. For instance, urban quality of life is a multidimensional phenomenon which can only be represented in a useful way by means of a vector with elements such as the quality, size and rent of dwellings, the availability of parks and recreation areas, traffic congestion, the quality and distance of urban facilities, etc. (see Nijkamp, 1980).

In general, an impact analysis should fullfil the following conditions (Nijkamp, 1979) : (1) integration of spatial elements, (2) inclusion of behavioural notions, (3) descriptions of coherence among systems components, (4) multidimensional representation of effects, (5) consideration of different institutional levels and goal conflicts, (6) inclusion of spatio-temporal developments, (7) policy-relevant definitions of variables, (8) examination of sensitivities and uncertainties in effects, and (9) no neglect of qualitative and intangible impacts.

Sometimes it may be useful to employ an impact structure matrix which reflects the effects of policy controls (p_1, ... , p_N) upon the systems components (c_1, ... , c_I) (see Figure 1.).

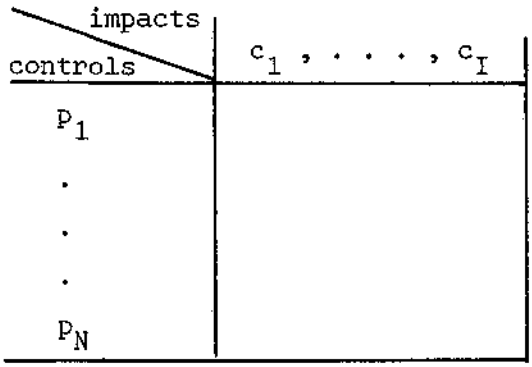


Figure 1. An impact structure matrix

An illustrative example of a spatial interaction system which might provide the information necessary to fill in the impact structure matrix is contained in Fig. 2.

It has to be added that the dynamics in such a (spatial) impact system may be the result of several forces: (1) autonomous developments (e.g., capital formation), (2) exogenous developments (e.g., rise in oil proces), and (3) policy measures (at either the systems level or the supra-systems level).

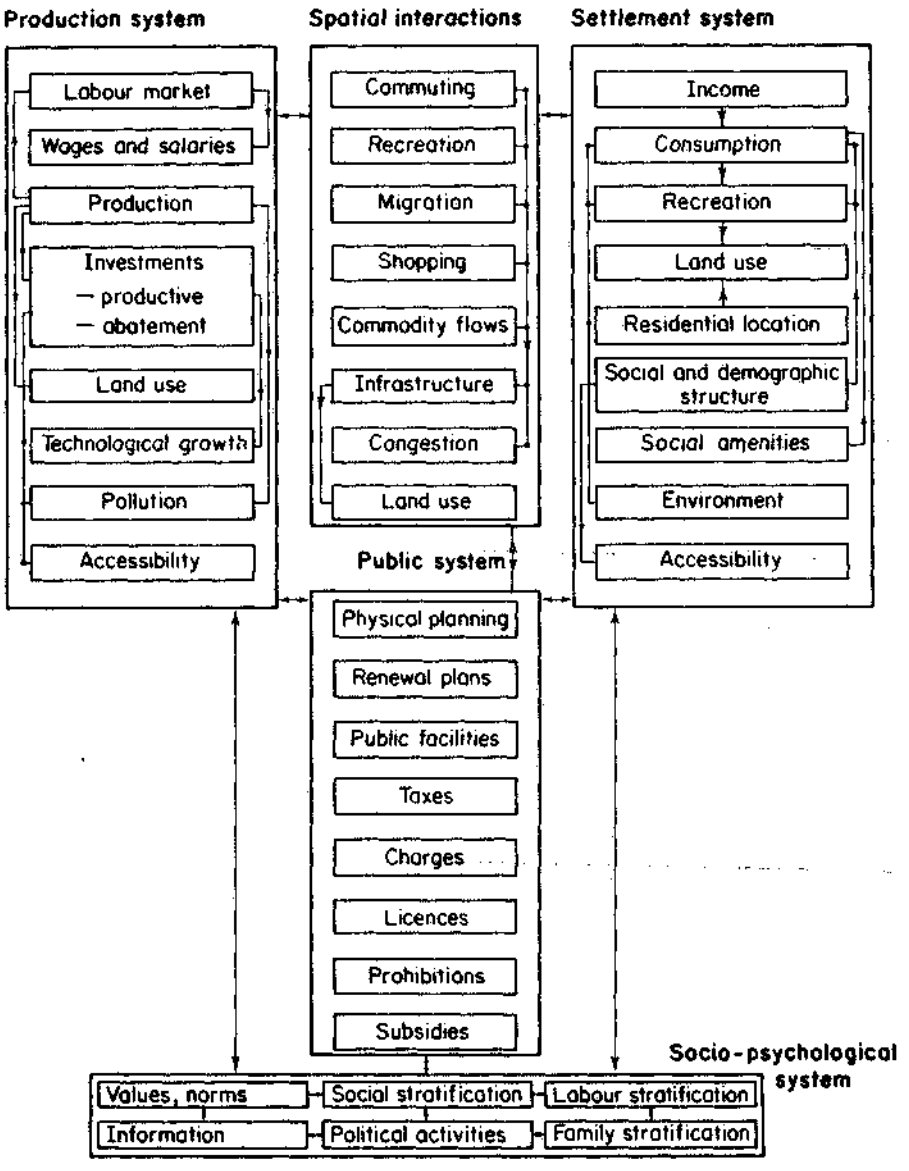


Fig. 2. An illustrative spatial interaction system.
Source: Nijkamp (1979, p. 24).

3. Urban Impact Analysis

Urban impact analysis is a specific kind of spatial impact analysis, as it focusses the attention on the impacts of public policy measures on the urban welfare profile. The idea of urban impact analysis was born at the end of the seventies, when President Carter's National Urban Policy imposed on federal agencies the task to assess - prior to the implementation of new federal programs - the expected subsequent changes on various relevant urban variables (finances, housing, accessibility etc.) (see Glickmann, 1979). Therefore, in general, urban impact analysis does not aim at estimating the effects of urban policies themselves nor of exogenous (non-policy) shifts; it aims at measuring the impacts of non-urban policies (for instance, regional, national or even international policies) on the urban system (see Fig. 3.), although in principle also impacts of intra-urban policies might be considered.

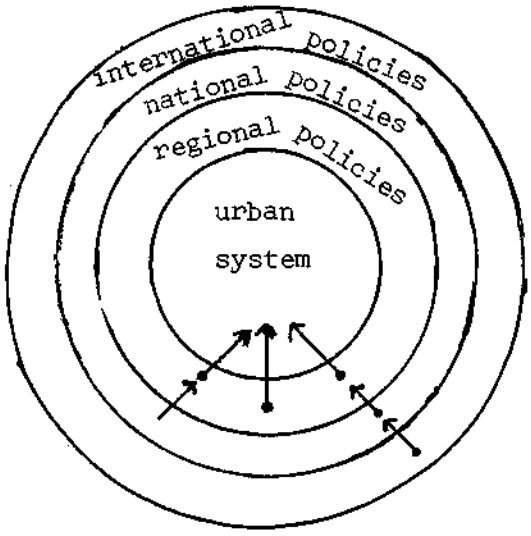


Fig. 3. An illustrative representation of urban impact analysis.

Fig. 3 indicates that higher-level impacts form the input for lower systems. Thus, urban impact analysis does not take into account the broader spatial impacts of intra-urban policies nor the intra-urban impacts of urban policies; urban impact analysis is particularly a top-down policy analysis of both intended and unintended effects. Clearly, intra-urban systems interactions can be dealth with.

It has to be added that there is a wide variety of regional and (inter) national policies: tax policy, energy policy, infrastructure policy, housing policy, health care, demographic policy, and so on. Each of these policy areas has a (multidimensional) set of relevant policy measures. Each measure may have a specific effect on the variables characterizing the urban system. As explained before, these variables can be grouped into more or less homogeneous or coherent urban welfare profiles (e.g., economic, social, infrastructural profiles).

This gives rise to the following illustrative structure of urban impact analysis (Fig. 4.).

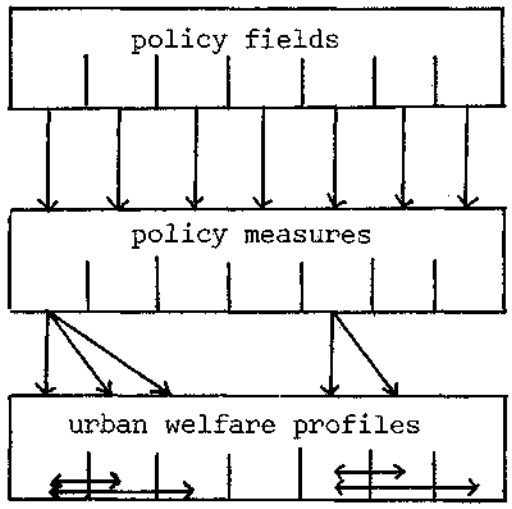


Fig. 4. Illustrative structure of urban impact analysis.

It should be noted that a certain policy measure may have impacts on several urban welfare profiles, while there may also be mutual interactive effects among urban welfare profiles (indicated by means of the horizontal arrows in Fig. 4.). The interrelationships within the urban system can be based on the spatial impact structure model discussed in the foregoing section.

A well-known problem inherent in any kind of spatial impact analysis is the spatial demarcation of the system concerned (in terms of cities, regions, etc.). From an analytical point of view, the spatial demarcation might be based on functional linkages between the spatial entities of the systems at hand, although data availability very often hampers the application of this standpoint. From a planning point of view, the spatial demarcations might be based on the existing administrative framework, although here also data problems may emerge.

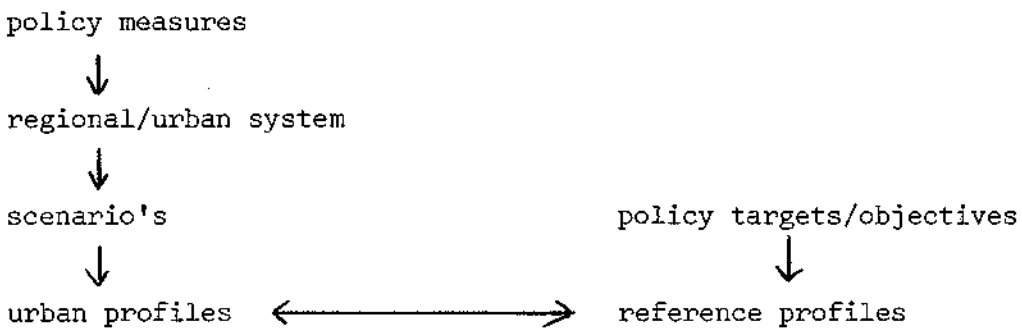
Finally, the time dimension in spatial and urban impact analysis has to be mentioned. Usually, an impact study is only based on a comparative static framework, so that a (dynamic) transition path is left out of consideration. The lack of reliability and validity of dynamic spatial and urban models hampers an application of these models in the field of impact studies. In this respect, many research efforts still have to be undertaken so as to reach a meaningful use of dynamic spatial models. In any case, it may always be worth while to make a distinction between impacts from the construction and the operating stage of a project, respectively. It should also be noted that - despite the absence of operational dynamic models - it may be meaningful to employ a step-by-step

impact analysis, so that the direct and indirect impacts of policy measures can be analyzed in a series of sequential stages (see later).

The range of impacts to be taken into account depends on the policy interests of federal and urban governments. The choice regarding both the number of profiles and the specific attributes of each profile is evidently also a policy decision, but it is clear that each specific set of impacts to be assessed should satisfy methodological requirements like systematics, coherence and completeness.

The problem of a systematic, coherent and comprehensive physical planning has recently received much attention in the Netherlands. In order to improve the co-ordination among different planning agencies and to speed up the implementation of proposed (and accepted) plans, the idea of a so-called Operational Area Assignment has been launched (see Raad van Advies voor de Ruimtelijke Ordening, 1980). The main purpose of this new planning structure is to avoid a planning process in which the interests of diverse policy areas (for instance, infrastructure policy and financial policy) are dealt with in a sequential way. Instead, a parallel planning process based on a simultaneous consideration and co-ordination of all relevant policy areas is proposed. It is evident, that these new ideas on a stream-lined planning process are in agreement with a comprehensive and integrated urban impact analysis.

The abovementioned impact system can easily be extended with a scenario analysis. A scenario analysis serves to investigate the impacts of (hypothetical) policy measures, so that these impacts can be confronted with (or judged on the basis of) a reference profile (e.g., a target profile) arising from policy targets or general objectives. The following system may clarify the foregoing remarks:



These elements will be further explored in the next sections.

4. A Systems Approach to Urban Impact Analysis

Given the need to obtain a comprehensive picture of all relevant (intended and unintended) urban effects of higher-level policies, a systems approach may offer a practical frame of reference for urban impact studies. In general, a systems approach aims at portraying the processes and relationships in a complex system that encompasses various components which are linked together by means of functional, technical, institutional or behavioural linkages and which can also be influenced by changes in parameters or controls from the environment outside the system itself (cf. Klir and Valach, 1967).

Then a formal systems representation of urban impact analysis can be given as follows. The set of profiles characterizing the successive parts of an urban system is denoted by $P = \{p_1 , \ldots , p_N\}$, while the set of attributes of each profile n $(n = 1 , \ldots , N)$ are denoted by $A_n = \{a_{n1} , \ldots , a_{nI}\}$. The compound representation of all attributes over all profiles may thus be represented as a set $A = \{A_1 , \ldots , A_N\}$.
We may also introduce a set of external (non-urban) policy fields $E_1 , \ldots , E_J$, which constitute part of the environment of the urban system. The specific policy measures associated with each policy field j $(j= 1 , \ldots , J)$ can be included in a set $B_j = \{b_{j1}, \ldots , b_{jM}\}$; the compound representation of all B_j's is represented as $B = \{b_1 , \ldots , b_J\}$. Thus the components of the system are denoted by $\{A , B\}$.

The interactions and relationships can be dealt with in a similar manner. Let $s_{n\,i\,n'i'}$ represent the relationship between any element a_{ni} and $a_{n'i'}$ within the urban system, then the set of internal relationships within the urban system can briefly be represented as $S = \{s_{n\,i\,n'i'} \; ; \; \forall n , n' , i , i' \}$. Let $r_{n\,i\,j\,m}$ represent the relationship between any element a_{ni} within the urban system and any element b_{jm} outside the urban system, then the impact relationships from external (non-urban) policies upon the elements of the urban welfare profiles can be denoted as $R = \{r_{n\,i\,j\,m} \; ; \; \forall n,i,j,m\}$. Then the following compound representation of an urban impact system U can be given : $U = \{A , B , S, R\}$. The set of relationships and interactions S and R may include all kinds of relations: series, parallel, feedback, and compound relations.

In an illustrative way the functioning of an urban impact system can now be represented as follows (see Fig. 5.).

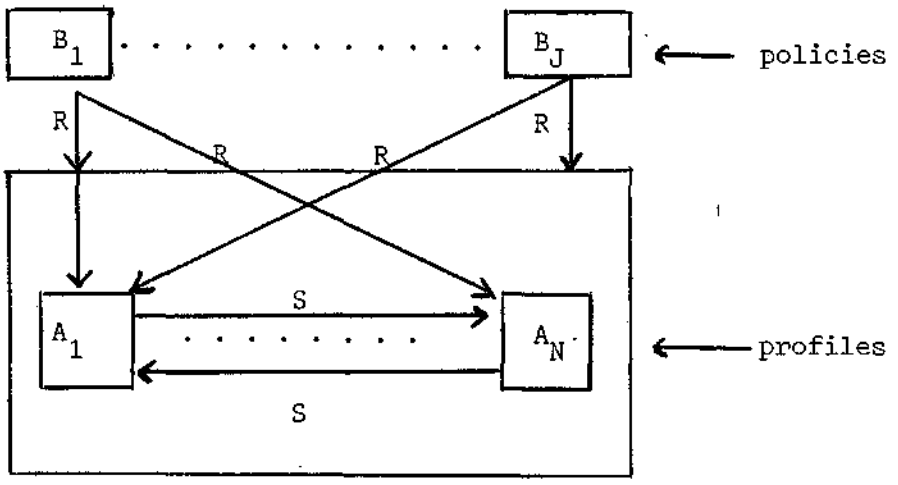


Fig. 5. Simple representation of an urban impact system.

The foregoing systems approach to urban impact analysis gives a systematic representation of the state of an urban system as well as of the urban responses of hierarchical (non-urban) stimuli. Clearly, more complicated systems with multiple cities and multiple policy levels can be treated in an analogous way.

It is evident that an integrated urban impact analysis requires data on the set of relationships S and R. These relationships might be represented by means of a formal econometric model (estimated by means of time series or cross-section data) or by means of graphs or arrows. The latter approach is more modest, as it does not require the construction of a comprehensive urban econometric model; in this case, however, frequently only qualitative statements regarding the responses of the urban systems to non-urban policy measures can be made (see also the following section).

A good example of a promising similar approach to integrated spatial modelling based on relationships between the elements of a multidimensional profile system is the so-called Integrated Environmental Model developed on behalf of the Dutch State Physical Planning Service by the Institute for Environmental Studies (cf. Arntzen and Braat, 1980a, 1980b, and Nijkamp, 1980).
In this (dynamic) model, the following main profiles were distinghuised: economic profile, demographic profile, ecological profile and facilities profile. The main structure of this model is represented in Fig. 6.

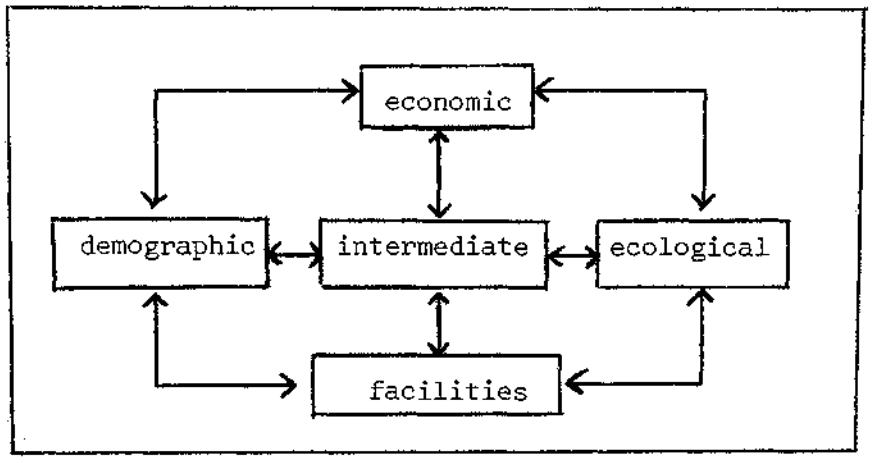


Fig. 6. Main structure of the Integrated Environmental Model

The parameters associated with the various relationships in this model has been calibrated, so that the effects of diverse physical planning and environmental policies could be assessed. Given the promising results of this multidimensional profile approach, it may be expected that - in the long run - a similar approach to urban impact analysis will be equally successful.

The abovementioned systems approach to urban impact analysis may be an operational tool in a co-ordinated national, regional and urban planning framework, especially when this approach is extended with a policy scenario analysis and policy simulation experiments (see also later).

5. Multidimensional Urban Impact Analysis

The various profiles and attributes thereof, as well as the successive relations between profiles and/or attributes, should provide meaningful information for an integrated policy analysis. In general, the following requirements should be met by an urban impact system:

- consistency: the relations should represent a set of coherent and non-contradictionary spatial interactions;
- completeness: the impact analysis should take into account the intended and unintended effects of non-urban policies upon the urban system;
- relevance: the various impacts and their indicators should be meaningful from the viewpoint of urban and regional management;
- pluriformity: the effects assessed by means of urban impact analysis should reflect the variety and multidimensionality of an urban system;
- comparability: the impact measures should allow a comparison with other impacts measured at different time periods or in different areas;
- flexibility: the impact system should provide comprehensible information which can be adjusted to the needs of users or to new circumstances;
- data availability: the impact analysis has to be oriented to the available data (including soft and qualitative information);
- comprehensiveness: the successive steps of the impact analysis should provide an integrated picture of spatial interactions including distributional impacts;
- effectiveness analysis: the assessed impacts should allow a confrontation with *a priori* set policy targets, so that the effectiveness of policy measures can be gauged.

In general, the multidimensional profile system discussed in the foregoing section will satisfy the abovementioned methodological requirements. It is clear, however, that the accuracy of measurement in many impact studies may be fairly low due to lack of data, uncertainties regarding policy measures, or lack of insight into the structure of a complex dynamic system.

Of course, impacts have to be measured on a scale which is as accurate and appropriate as possible, but frequently only soft or qualitative information is available. For a meaningful policy analysis, this information should not be disregarded.

In general, the following measurement scales may be distinguished (cf. Harvey, 1969):

- nominal scale: a classification into distinct groups (e.g., green or red) or into distinct size classes (e.g., small impacts and large impacts);
- ordinal scale: a ranking of events or effects in order of magnitude (e.g., 1, 2, 3, 4, ...);
- cardinal scale: a measurement system which allows a calculation of distances between effects, either in a relative sense (an interval scale) or in an absolute sense (a ratio scale).

The effects assessed in urban impact analysis may be measured in any of these scales depending on the accuracy of the information. In case of a large set of ordinal measured impacts, it may sometimes be meaningful to transform the ordinal information into metric (cardinal) units by means of multidimensional scaling (see Nijkamp, 1979). This is especially useful if one wants to reduce ordinal information on a long list of attributes of a certain profile to some main (metric) indicators of the profile at hand.

Meaningful classes of main profiles in urban impact analysis may be inter alia:

- economic : production
  investments
  labour market
  demand, etc.
- housing : quantity of dwellings
  quality of dwellings
  residential climate
  prices and rents, etc.
- infrastructure : accessibility (public and private transport)
  distance
  mobility (migration, commuting, recreation, shopping), etc.
- finances : taxes
  subsidies
  public expenditures
  distributional aspects, etc.
- facilities : health care
  cultural
  social
  recreational, etc.

- environmental : air pollution
  noise
  sewage systems
  congestion
  segregation
  density, etc.

- energy : energy consumption
  insulation of dwellings
  central urban heating system
  tariff system, etc.

Depending on the aim of a specific urban impact analysis, a choice among the foregoing impact profiles (including their levels of measurement) has to be made in order to set up an integrated urban impact system.

Normally, it is very useful to regard an impact analysis as a way of studying shifts in the existing urban system. This implies that a frame of reference has to be used in order to meaningfully interpret the effects. This frame of reference may be a (passive) zero alternative of the urban system concerned, but it may also be an 'active' variant based inter alia on the urban system that may be attained by means of e.g. the best technological or environmental means.

Part B

DUTCH CASE STUDY *

*) The author is indebted to Ron Janssen for his help in this case study.
The author also acknowledges the assistance of Bureau TERP in Amersfoort, which made available the data for this case study.

6. Brief Survey of Some Dutch Planning Issues

Economic policy, urban management, regional policy, environmental and energy management, and infrastructure policy are some key issues in current Dutch planning practice.

Economic policy is mainly based on the so-called principle of selective growth. This implies a twodimensional approach in economic planning, viz. both an emphasis on a favourable structural development and a consideration of boundaries set by the environmental, energy and Third World interests. The first issue of Dutch economic policy is essentially a traditional economic growth and employment issue, in which public policy aims at furthering a healthy economic structure and related growth processes of all sectors. The second issue is more concerned with the problems emerging from the new scarcity: environmental deterioration and unfavourable working conditions, energy shortage, and skew international division of wealth and employment opportunities. According to the selective growth option, a further growth of the economy should be realized with the constraints arising from environmental, energy and Third World facets.

Urban management in the Netherlands has to be oriented to a restoration and improvement of urban functions, so that cities become again the nuclei of a spatial system. Consequently, the process of desurbanization that has taken place in the seventies has to be re-oriented, long-distance commuting has to be reduced, and urban revitalization has to be furthered rigorously. This also implies that cities should provide sufficient and satisfactory dwellings and job opportunities. In addition, the overflow of people has to be directed toward a limited number of growth centres, so that the urban sprawl - especially in the Western part of the Netherlands - can be better controlled.

Regional policy in the Netherlands addresses itself to two main topics, viz. a general improvement of all elements of a regional welfare profile (especially in the peripheral areas) and a reduction of the interregional disparities between the prosperous and lagging regions. During the last decades, a whole system of subsidies, investment premiums and social overhead investments has been set up in order to provide better conditions for lagging regions in the Netherlands. It is clear that especially in a period of economic recession the success of regional policy is fairly moderate.

Environmental and energy management in the Netherlands is a field full of controversies and conflicts. During the seventies, environmental policy has developed into a rather strict system of regulations on air pollution, water pollution, noise annoyance and solid waste. Standards, regulations and charges are the main instruments of environmental policy. Energy policy has a less definite shape; it is mainly based on charges and /or price increases caused by

external factors, although subsidies on energy-saving measures are becoming increasingly important.

Infrastructure policy aims at providing favourable conditions for a balanced spatial development, while at the same time it aims at tackling undesirable spatial developments (such as an energy-intensive transportation network). A reduction of the negative aspects of spatial mobility has become one of the key issues in infrastructure policy, especially in the densely populated Western part of the country.

In the beginning of the seventies, a spatial law on a so-called selective investment regulation (SIR) has been adopted in order to stimulate private entrepreneurs to implement less investments in the Randstad (the densely populated Western part of the country) and to direct new investments to other areas. This system was based on permissions and charges on less desirable investments in the Randstad. The system has never become a great success due to the emerging economic recession.

At the end of the seventies, a new law on so-called investment accounts (WIR) has been introduced, which was meant as a general tool to stimulate favourable investments. Depending on the area at hand, the size of the investment and the degree of labour intensity, a certain investment premium can be granted by the Dutch government.

Some more details on the SIR and WIR are contained in Annex A.

In conclusion, this sample of Dutch planning issues demonstrates that many modern problems associated with the new scarcity have received a key position in Dutch planning practice. Analogously, many research efforts have been undertaken to provide a scientific and analytical basis for the various policies. In the field of regional development, economic structure analysis, urban rehabilitation, environmental pollution, energy shortage and infrastructure numerous studies have been carried out in order to provide better insights into the complicated mechanism of mutually coherent spatial developments.

The foregoing remarks also indicate that urban impact analysis as such does not exist in the Dutch planning system, at least not in the abovementioned specific sense (although many kinds of research have been undertaken that bear a great similarity to urban impact analysis). There is only one kind of impact analysis which has drawn much attention in the recent past, viz. environmental impact analysis. The latter impact analysis, however, has not yet officially been accepted, although it is already for more than 5 years under study. The main reasons for this delay are : (1) lack of an institutional system for incorporating environmental impact analysis in the existing planning framework, and (2) lack of a satisfactory methodology for analyzing the intricate web of environmental

interactions in relation to economic and infrastructural decisions (Nijkamp et al., 1981).

Given these experiences, one may question the relevance and succesfulness of urban impact analysis in the Dutch planning system. In our view, however, it would be a great mistake to reject urban impact analysis because of lack of satisfactory possibilities for integrating it in the current planning context. The aim of urban impact analysis is precisely to improve urban and regional policies by providing it with a better and more appropriate foundation.

Therefore, in order to avoid a long-lasting delay due to extensive discussions on the planning context and the methodology of urban impact analysis, it is more meaningful to examine whether urban impact analysis can be incorporated in (1) the current Dutch physical planning framework of so-called preparatory plans, regional plans and local plans and (2) the current regional and urban research methodology.

In our view, urban impact analysis may become an integral part of the current system of preparatory plans, regional plans and local plans in Dutch physical planning. An introduction of urban impact analysis would imply that the public agency responsible for the design of a plan should conduct an analysis of the urban impacts of the plan in question and include the results of the study in a documentation regarding the planning proposals.

As far as the methodology of urban impact analysis is concerned, given the many experiences in the field of urban and regional research in the Netherlands, there seems to be no need for an entirely new research methodology, as is also demonstrated by the urban impact system described above. It would be a more appropriate strategy to link the fundamentals of urban impact analysis discussed above to the existing analytical tools developed in Dutch urban and regional research.

Therefore, in the next sections an attempt will be made to investigate - on the basis of a case study - the possibilities of employing results from current regional and urban research in the framework of the urban impact methodology set out before.

7. Description of a Case Study [1)]

The case study that will be discussed here concerns an area in the southern part of the Dutch Randstad, called Midden-Holland (MH). The regional centre in this area is the city of Gouda (see Map).

The Randstad is composed of an outer ring of mutually connected agglomerations, viz. Amsterdam, The Hague, Rotterdam and Utrecht, which together include a central 'green area'. This central 'green area' forms an attractive landscape with agricultural and recreational uses. Consequently, this 'green area' is characterized by severe restrictions regarding housing constructions, industrial development and infrastructure.

The central region in this open area is MH; it is mainly agriculturally oriented. Its central city is Gouda; it has good road and railway connections with the major agglomerations in the Randstad. Hence, MH is characterized by two features:

- the area is an attractive residential area due to its rural character in the desisely populated Randstad, so that in the post-war period a significant immigrations of households has taken place, leading to large commuting flows to the major agglomerations;
- the area is an attractive central location for entrepreneurs, so that there is a strong movement of firms toward this area.

Consequently, the economic and spatial perspectives of MH have been a source of major concern for public policy.

In the framework of economic policy the developments of MH has to be strictly controlled because of environmental conditions, although it has an enormous economic growth potential. A reinforcement of the existing industrial structure and the creation of job opportunities which is in agreement with the existing demographic structure are the major aims of economic policy.

The urban policy of the city of Gouda has to be implemented in an area characterized by several conflicts. On the one hand, Gouda serves as a propulsive regional growth centre for the region MH due to the large concentrations of services and facilities; on the other hand more housing programmes in the city of Gouda may facilitate the maintenance and protection of the 'green area' in the Randstad. In practice, a housing policy has been adopted which is sufficient for the natural increase of MH, so as to restrict a further immigration and its subsequent commuting flows.

1) Sources: Streekplan Zuid-Holland Oost, The Hague, 1980.
Voorontwerp Structuurplan Gouda, Gouda, 1980.
De Regionale Economie in Midden-Holland, Amersfoort, 1980.

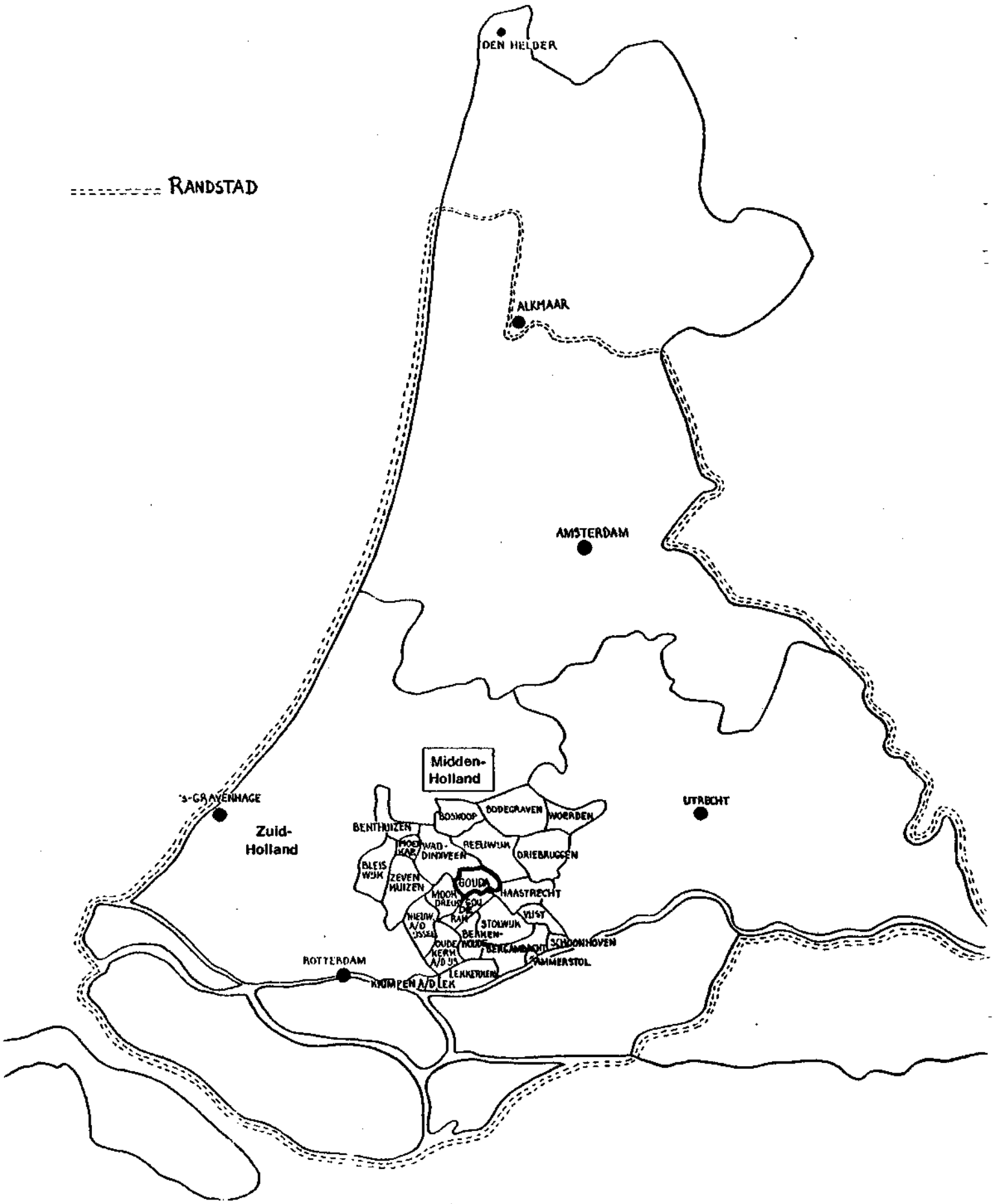
MH is certainly not an unfavourable peripheral area, so that the regional policy for this area has mainly been oriented toward a control of unfavourable regional developments (for instance, via the SIR-instrument).

Environmental policy in this area has received a high priority due to vulnerable ecological and environmental structure in the Dutch Randstad. In practice, this implies that environmental policy forms a set of constraints for all other facets of public policy. Examples are prohibitions for housing construction and industrial activities in many parts of this area.

Finally, an important public policy instrumentis provided by infrastructure policy, among others by restricting the number of new areas for housing construction and railway and road construction. This leads of course to strong land use competition and high land rents of areas earmarked for residential and industrial use, but it also gives many possibilities for a selective land use policy by local and regional authorities.

Finally, the abovementioned instruments of the SIR and WIR will briefly be discussed. Although these instruments (especially charges, prohibitions and lower subsidies) might worsen the relative position of MH, it turns out that, in general, the central location of this area leads to a very strong position, so that a significant decline could not be observed.

Now the question arises as to whether the urban impact methodology developed in the foregoing sections can meaningfully be employed in order to extract useful information from the abovementioned regional (research) reports. It will be shown that various planning facets can simultaneously be taken into account and that the abovementioned profile approach is (partly) feasible on the basis of the (restricted) available information. This will be the subject of the next section.


RANDSTAD
DEN HELDER
ALKMAAR
AMSTERDAM
UTRECHT
's-GRAVENHAGE
ROTTERDAM
Zuid-
Holland
Midden-
Holland
BOSKOOP
BODEGRAVEN
WOERDEN
BENTHUIZEN
REEUWIJK
DRIEBRUGGEN
BLEISWIJK
ZEVENHUIZEN
GOUDA
HAASTRECHT
STOLWIJK
VLIST
SCHOONHOVEN
KRIMPEN A/D LEK

8. A Multidimensional Profile System for Regional-Urban Impacts

The urban impact system described in this section will be presented in two steps: (1) a presentation of the structure of the regional-urban system at hand by means of a multidimensional profile approach, and (2) a presentation of a policy impact system that can be linked directly to the abovementioned system.

The multidimensional profile system for the city of Gouda is built up by means of the following main profiles:

- entrepreneurial activities (investments, production, etc.)
- employment (demand and supply on the labour market for various categories, etc.)
- demographic and residential pattern (population structure, demand for housing, migration, etc.)
- transport and traffic (commuting, etc.)
- infrastructure (roads, industrial areas, etc.)
- quality of life (residential climate, recreation, etc.).

These profiles defining the state of the urban system concerned can be linked together in the following figure describing the (simplified) structure of the urban system:

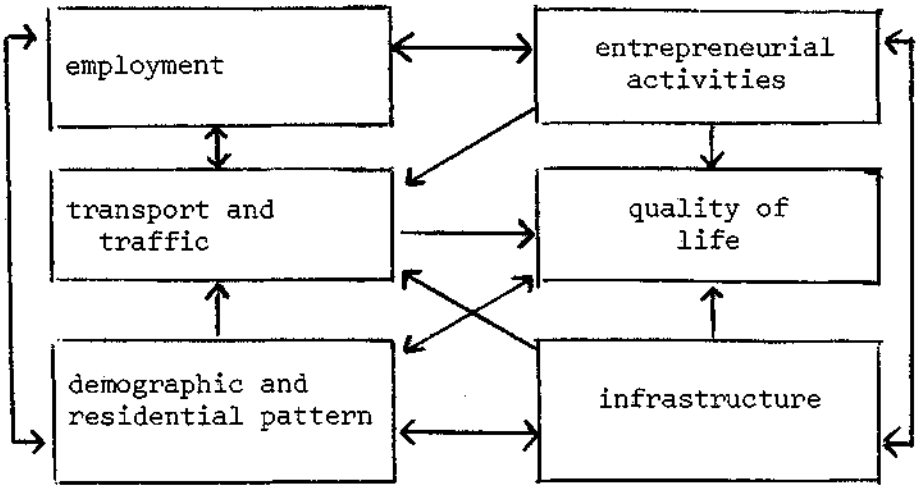


Fig. 7. Simple structure of urban system.

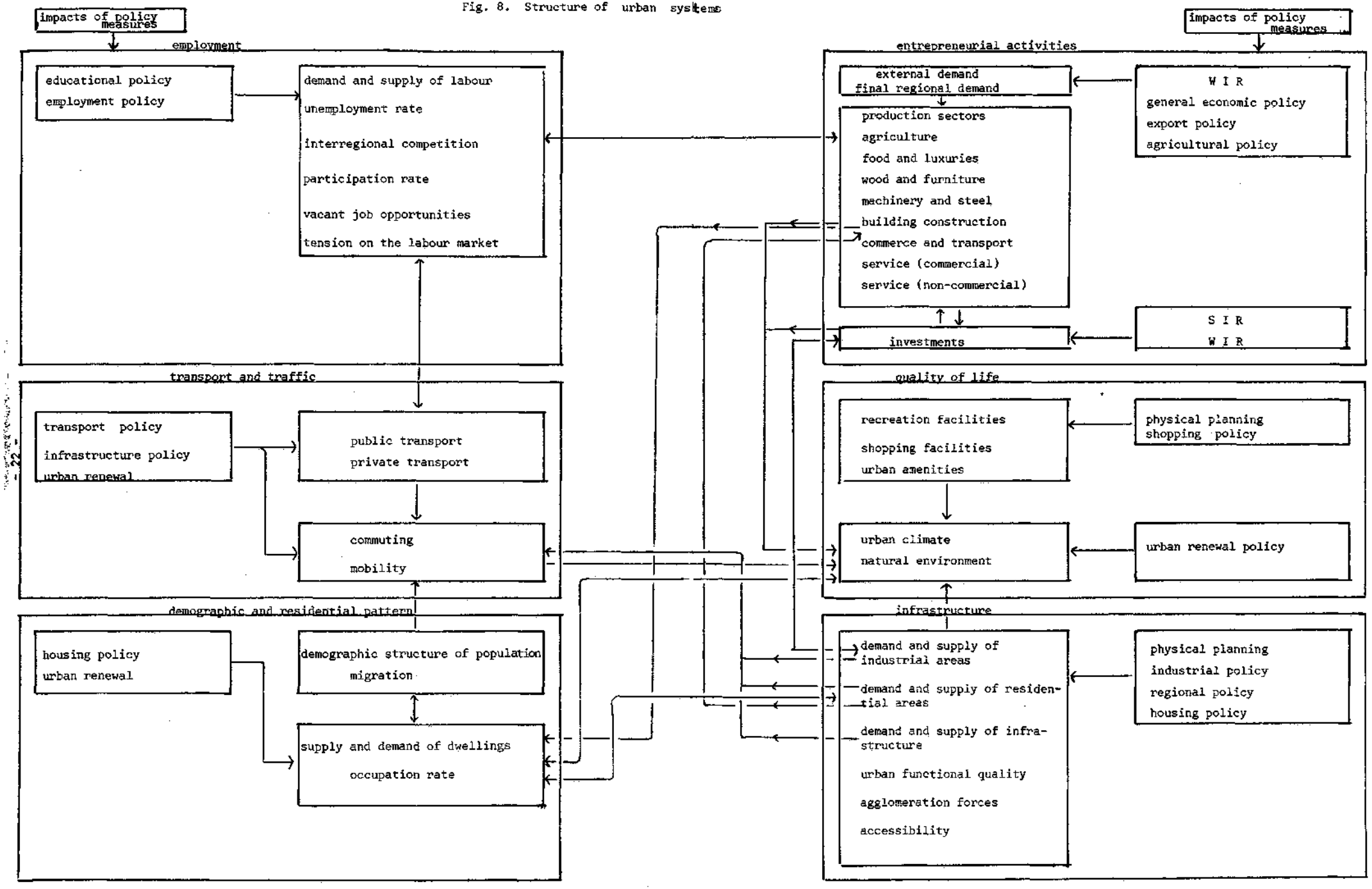
The arrows in this figure represent the major relationships between the 6 main profiles. It should be noted that in this figure no distinction is made between intra-profile and inter-profile relationships associated with the attributes of the successive profiles. This would require a more detailed representation of all linkages between the elements of the profiles. An attempt at providing such a more complete picture is found in Fig. 8.

This figure formed the basis for performing an urban impact analysis for the city of Gouda. The structure of this picture was co-determined by the available information contained in the abovementioned regional and urban(research) reports on Gouda and MH. Thus, only those relationships which could be assessed on the basis of existing data,have been included. It should be remarked that the policy impact structure has also been included in this picture. This will be discussed in greater detail in the next session.

The picture itself demonstrates the most important issues of socio-economic and physical planning of Gouda and MH (such as immigration policy, housing policy, industrial development, employment, centrality of Gouda, environmental quality, etc.).

The picture can be elaborated by making a more precise distinction between supply and demand profiles (for instance, for housing, infrastructure, industrial areas, etc.) In this respect, it would be more appropriate to assess the impacts of public policy measures, as they have mainly an impact on the successive supply profiles. In an elaborated version of Fig. 8 a more detailed picture of the regional urban interactions has been given. The same holds true for sectoral interdependencies within the region itself. A representation of this extended impact system will be given in a subsequent study report. This extended impact scheme is also very suitable for analyzing the impacts of policy scenario's. This will also be discussed more thoroughly in the next section.

Fig. 8. Structure of urban systems



9. Impacts of Non-Urban Socioeconomic and Spatial Policies

In Fig. 1 a distinction has been made between urban, regional, national and international polices. A socioeconomic policy impact system may relate to the following issues at these four levels:

- urban : housing
  public transport
- regional : housing
  public transport
  SIR
  WIR
  urban renewal policy
  industrial area policy
  investment policy
  shopping centre policy
- national : housing
  public transport
  WIR
  general economic policy
  employment policy
- international : infrastructure policy
  regional policy
  agricultural policy.

In the framework of urban impact analysis, the effects of the three last mentioned policies on the urban system have to be assessed. Consequently, the urban system described in Fig. 7 and 8 was extended with a set of policy measures that exert an influence (direct and indirect) on the main profiles and their related attributes. Clearly, the urban impacts are only measured in one (top-down) direction, viz. from the regional, and (inter)national level toward the urban system; (bottom-up) feedback relationships are not analyzed.

As set out in section 8, it is possible to make a subdivision of profiles into supply and demand categories so as to assess more precisely the impacts of ploicy measures.

The next step is to define a set of public policies that, in combination, exert an impact on the urban system through the successive profiles. Of course, there are numerous policies. Therefore, in the context of our study it seems appropriate to define only a limited number of policy scenario's which are composed of different combinations of the abovementioned policy measures (see next section).

The impacts of these policy scenario's on the various profiles can be

confronted with target profiles which can be formulated for the area by the regional and urban authorities. These target profiles which can inter alia be derived from the area plans and urban goals memorandums form the frame of reference for judging the impacts of the successive policy scenario's.

The following general target profiles can be formulated:

employment and entrepreneurial activities

- a full employment
- reducing extra-regional commuting by creating an equilibrium between regional supply and demand of labour
- a great variety of (highly qualified) labour in the city of Gouda
- development of Gouda toward a primary employment centre
- development of the centrality functions of Gouda
- fulfillment of demand for industrial areas.

demographic and residential pattern

- natural population increase of regions should be directed toward Gouda
- housing policy should be in agreement with environmental requirements (landscape, etc.)
- no substantial changes in population structure
- fulfillment of demand for dwellings (inter alia via urban renewal)
- a better spatial integration of living, working and facilities.

transport and traffic

- reduction of commuting
- further development of public transport
- a better function of traffic and transport in the city and in the region.

infrastructure and quality of life

- maintenance of the natural landscape of the region
- a more adequately integrated urban structure
- improvement of the quality of spatial and architectural aspects of the urban climate
- protection of landscape and natural environment against further decay.

The next section will be devoted to a description of a set of meaningful policy scenario's so as to confront the related changes in the profiles with the abovementioned target profiles.

10. Scenario's for Urban Impact Analysis

As explained before, it may be extremely useful to employ a set of alternative policy scenario's in an ex ante urban impact analysis. Such scenario's may inter alia relate to:

- investment behaviour of entrepreneurs. Examples of related policy measures are:
  - . the SIR-system which aims at spatially controlling investments in MH via a system of charges, so as to achieve a selective structural growth pattern (see Annex A).
  - . the WIR-system which inter alia aims at coping with the economic recession. The physical planning subsidies and the special regional subsidies,however, are not applicable to MH. On the other hand, these subsidies are applicable to Nieuwegein and Zoetermeer , so that these subsidies provide a competitive framework in detriment of Gouda.
- physical planning measures. Examples of related policy measures are:
  - . control of housing construction and hence of population development
  - . provision of industrial areas and infrastructure
  - . subsidies on modernization of shopping facilities
  - . active urban renewal measures (though a special public regulation for financing urban renewal, the so-called 'interim saldo regeling', is not applicable to Gouda).
- national and international policy measures. Examples of related policy measures are:
  - . national energy policies (having impacts on environmental conditions through interfuel substitution)
  - . agriculture policy of the E E C (having impacts on the food industry which is a major economic activity in the region of MH).

On the basis of the successive policy measures mentioned before, one may create scenario's by formulating some general policy aims and related measures and, next, by assessing the urban impacts of these policy measures.

In the framework of an case study 4 different scenarios' have been distinguished. They will briefly be discussed here.

Scenario A

Aims: . satisfactory residential needs
. fulfilling the general desire for spatial mobility (inter alia commuting)

Measures : . construction of new dwellings
. provision of new road infrastructure.

Scenario B

Aims : . slight reduction of commuting
. satisfying residential needs
. reinforcement of the centrality function of Gouda

Measures : . construction of new dwellings
. reduced extension of infrastructure network
. WIR-system
. building a regional industrial area in Gouda and some local industrial areas elsewhere.

Scenario C

Aims : . satisfying residential needs
. strong reduction in commuting
. reinforcement of the centrality function of Gouda.

Measures : . construction of new dwellings
. building a central regional industrial area and local industrial areas
. WIR-system
. reduced supply of infrastructure.

Scenario D

Aims : . significant reduction of commuting flows in order to stimulate residential activities near working places
. further development of main agglomerations (Rotterdam, The Hague, Utrecht) as primary residential and working centres.

Measures : . SIR
. urban renewal in main agglomerations
. no construction of new dwellings in MH
. no construction of road infrastructure in MH.

The abovementioned scenario's offer an operational perspective for assessing the urban impacts of non-urban policy measures. The choice of specific impact profiles is a result of policy plans ('targets') formulated in advance, while the effectiveness of alternative policy measures can be estimated via the impact system. Thus, the following illustrative scheme can be used, which confronts the left-hand ('demand') side with the right-hand ('supply') side:

Fig. 9.: Representation of a scenario analysis.

Having defined now in general terms a set of 4 non-urban policy scenario's, one may attempt at gauging the urban impacts on Gouda as a set of expected consequences of the related policy measures. This will be the subject of the next section.

11. An Urban Impact Analysis of Four Policy Scenario's

It has been explained in the multidimensional profile system discussed above that the impacts of non-urban policies may have both a direct and an indirect impact on the various profiles. According to the integrated impact system described in Fig. 8 a certain policy measure may affect directly one or more profiles, and next - through the system of interactions - also all other profiles. In our view, it is extremely important to assess also these indirect impacts. Of course, it would be ideal if an integrated mathematical model were available, so that all impacts could easily be estimated. But even in a situation where such a model is lacking, one may use as a provisional step the above-mentioned impact scheme in order to assess in a series of subsequent steps the expected impacts of the non-urban policy scenario's on Gouda. Of course, this contains sometimes inaccurate and even qualitative information. The qualitative information on a certain effect is indicated as : + + (relatively large positive impact), + (relatively small positive impact), 0 (negligible impact), - (relatively small negative impact), -- (relatively large negative impact), and ? (unknown impact).

The impacts of the successive scenario's on the 6 main profiles are represented in a stepwise way in Tables 1-4. The data in these Tables are extracted from or estimated on the basis of the regional (research) reports mentioned in section 7. The information underlined with dashed lines pertains to urban impacts, all other information to regional impacts, while the double marked cells reflect the direct policy measures themselves.

The nine steps of this impact matrix are presented in a sequential way. If more accurate time series data were available, these steps would have been represented in a series of time periods, so that the dynamic impacts of policy scenario's could have been assessed. The choice in favour of nine steps rests upon the assumption that, after all the successive related impacts (which can be derived from the impact scheme in Fig. 8), the consequences of the initial policy measures cannot be gauged anymore in a reliable way. This is caused by the fact that after several steps either new (or complementary) policy measures will be adopted or changes in exogenous developments preclude a further assessment of indirect impacts.

It should be noted that not all elements of the policy scenario's are included in the first step of the impact scheme; they are only introduced in this scheme when the successive impacts on the urban system require these measures to be taken. The order of the elements of the policy scenario's in this impact matrix can also directly be derived from the impact scheme of Fig. 8.

As a whole, it turns out that the use of the impact scheme in combination with policy scenario's provides a useful practical framework for socioeconomic and physical planning.

Table 1. Stepwise impact matrix of scenario A for main profiles

profile \ step	1	2	3	4	5	6	7	8	9
demographic and residential pattern			net increase in stock of dwellings: + 14700 + 4668	change in population: + 24000 + 5970 change in occupation rate: - 0.31 - 0.27				impact on immigration: -	impact on population size: -
employment			impact on demand for labour in building construction: + +	change in demand for labour in wood and furniture sector: + idem for machinery and steel sector: + change in participation rate +	change in job opportunities: - 18000 - 4700 change in vacant job opportunities: - 1000 - 200	unemployment + 3000 + 1000 change in tension on the labour market -			
entrepreneurial activities		construction of: 15800 houses 5567 houses	investments in construction sector: + production change in wood and furniture sector + + production change in machinery and steel sector: +	change in investments in wood and furniture sector: + idem for machinery and steel sector: +	change in intraregional final demand of consumers: +	impacts on production in all sectors: +	impacts on new investments: +		impact on accessibility 0
transport and traffic					change in traffic flows: + +	impact on demand for local infrastructure: + + impact on commuting (in): - 1000 0 impact on commuting: +13000 (out) + 3500 impact on intrareg. commuting: + 500	impact on supply of local infrastructure: + + impact on demand for interlocal infrastructure + +	impact on supply of interlocal infrastructure: + +	
quality of life			impact on urban quality of life: ? impact on natural environment: -		change in demand for recreation facilities: + + change in demand for other facilities: + +	impact on urban quality of life : - -	impact on quality of natural environment: - - impact on urban quality of life: - -	impact on quality of supply of recreation facilities: -	
infrastructure	land use assignment for buildings 15800 houses 5567 houses	impact on available land due to provision of land for: recreation - industry - infrastr. -							impact on available space for: recreation - industry - dwellings -

Table 2. Stepwise impact matrix of scenario B for main profiles

step / profile	1	2	3	4	5	6	7	8	9
demographic and residential pattern			increase in stock of dwellings: + 14700 + 4668	change in population: + 24000 + 5970 change in occupation rate: - 0.31 - 0.27				impact on immigration: 0	impact on population size: 0
employment			impact on demand for labour in building construction: + +	change in demand for labour in wood and furniture sector: + idem for machinery and steel sector: + change in participation rate +	change in job opportunities: - 5000 - 0	change in unemployment 0 change in vacant job opportunities 0 change in tension on the labourmarket 0			
entrepreneurial activities	W I R	construction of 15800 houses 5567 houses	investment in construction sector: + prod. change in wood and furniture sector : + + idem in machinery sector : +	investment in wood and furniture sector : + idem in machinery sector : +	change in intraregional final demand of consumers +	impacts on production in all sectors : +	impacts on new investments +		impacts on accessibility 0
transport and traffic					change in traffic flows + +	impacts on demand for local infrastruct. + + on commuting (in) 0 on commuting (out) + 5000 + 1000 on intrareg. commuting + 2000	impacts on supply of local infrastructure + impacts on demand for interlocal infrastructure + +	impact on supply of interlocal infrastructure +	
quality of life			impact on urban quality of life ? impact on natural environment -		change in demand for recreation facilities + + idem for other facilities + +	impact on urban quality of life - -	impact on quality of natural environment - impact on urban quality of life - -	impact on quality of supply of recreational facilities -	
infrastructure	land use assignment for building 15800 houses 5567 houses idem for industrial activities 125 ha 55 ha	impact on available land due to provision of land for: recreation -							

Table 3. Stepwise impact matrix of scenario C for main profiles

profile \ step	1	2	3	4	5	6	7	8	9
demographic and residential pattern			net increase in stock of dwellings + 14700 + 4668	change in population + 24000 + 5970. change in occupation rate - 0.31 - 0.27					
employment			impact on demand for labour in building construction + +	change in demand for labour in construction sector + + machinery and steel sector + + wood and furniture sector + change in participation sector + +	change in job opportunities + 6000 + 4300	unemployment - 1000 - 400 vacant job opportunities + 2000 + 450 change in tension on the labour market + +			demand for labour -
entrepreneurial activities	W I R	construction of 15800 houses 5567 houses investments + +	investments in construction sector + + production change in machinery and steel sector + + wood and furniture sector +	change in investment in machinery and steel sector + idem for wood and furniture sector +	change in intra-regional final demand +	impact on production in all sectors +	investments -	production in all sectors - accessibility -	accessibility - investments -
transport and traffic					change in traffic flows + +	impact on demand for local infrastructure + + impact on commuting (in) + 4000 + 1000 commuting (out) + 1000 + 250 intraregional commuting + 10.000	impact on supply of local infrastructure + impact on demand for interlocal infrastructure + +	impact on supply of interlocal infrastructure +	
quality of life			impact on urban quality of life ?- impact on natural environment		change in demand for recreational facilities + + idem for other facilities + +	impact on urban quality of life - -	impact on quality of natural environment - impact on urban quality of life -		
infrastructure	land use assignment for building 15800 houses 5567 houses idem for industrial activities 260 ha	impact on available land due to provision of land for : recreation -							

Table 4. Stepwise impact matrix of scenario D for main profiles.

profile \ step	1	2	3	4	5	6	7	8	9
demographic and residential pattern			net increase in stock of dwellings 0	change in population - 17549 - 5806 change in occupation rate - 0.31 - 0.27					
employment			impact on demand for labour in construction sector - -	change in demand for labour in construction sector - - machinery and steel sector - - wood and furniture sector - change in participation rate	change in job opportunities + 3260	unemployment - 300 - 100 vacant job opportunities + 200 + 100 change in tension on the labour market +			
entrepreneurial activities	S I R	investments - - production in construction sector - -	production change in construction - machinery and steel sector - - wood and furniture sector -	investments in construction sector - - machinery and steel sector - - wood and furniture sector -	change in intra-regional final demand -	production in all sectors -	investments - accessibility +		
transport and traffic					change in traffic flows -	impact on commuting (in) + 500 + 50 commuting (out) - 2250 - 750 intraregional commuting - 1000			
quality of life			impact on urban quality of life ? impact on natural environment +		change in demand for recreational facilities - idem for other facilities -	impact on urban quality of life +	impact on urban quality of life + quality of natural environment +		
infrastructure	no land use assignment for building houses or for industrial activities								

12. Conclusion and Evaluation

The results of the foregoing exploratory study on urban impact analysis will now briefly be summarized:

1. Urban impact analysis offers an operational tool for assessing direct and indirect, intended and unintended, short-term and long-term consequences of non-urban public policies.

2. In the Dutch planning framework, urban impact analysis can be integrated in the existing structure of regional and urban research, although two frictions may emerge:
   - it is sometimes difficult to disentangle precisely urban effects and regional effects due to the openness of a spatial system.
   - the existing research methodology is not precisely oriented to the development of comprehensive impact systems.

3. The use of a multidimensional profile method offers fruitful ways of developing integrated impact systems, which can - in principle and at least to a certain extent - be combined with the vast majority of existing urban and regional research.

4. No entirely new urban impact methodology would be necessary when the multidimensional impact methodology suggested in this study were adopted in the Dutch planning system, though the creation of urban data banks would facilitate the tasks of urban impact analysts and would also lead to more reliable outcomes.

5. In the long run, the construction of dynamic impact models might be necessary, but for the time being the use of a step-by-step impact matrix that incorporates also the policy measures in a stepwise way is already a fairly satisfactory first stage of urban impact analysis.

6. Urban impact analysis is not necessarily oriented to hard and reliable information, but may also address the problem of soft and uncertain information on urban impacts. This also holds true for unintended or intangible effects.

7. By creating target profiles as a frame of reference, the results and effectiveness of various policy scenario's can easily be confronted with general urban desires concerning the successive urban welfare profiles.

8. The use of policy scenario's is extremely important for assessing the effects of a set of (hypothetical) coherent policy measures so as to provide policy-makers with satisfactory ex ante information concerning expected impacts of policy measures. In this respect, simulation experiments may also be extremely helpful additional tools.

9. Urban impact analysis need not necessarily be an expensive, long-lasting research effort that will only increase the costs of regional and urban policies. By providing in advance in a systematic way relevant information on urban impacts, the citizen participation can be better structured and be organized in a more efficient way. Instead of a delay, urban impact analysis might speed up the policy planning and procedures, especially because in this way policy-makers may anticipate unintended effects.

10. Urban impact analysis can be integrated with the existing Dutch planning system of preparatory plans, regional plans and local plans, as it may provide part of the scientific basis for generating alternative solutions and for seeking desired solutions. It would also fit in the abovementioned recently proposed procedure of Operational Area Assignment (OGA).

11. Before urban impact analysis should be introduced, a limited number of representative pilot studies have to be carried out in order to further identify the strengths and weaknesses of applying urban impact analysis in the Dutch planning system.

Annex A. The system of SIR and WIR

The SIR-system aims at (1) reducing the negative externalities accruing from the emergence of large spatial concentrations of economic activities and/or population, and (2) contributing to a more satisfactory spatial dispension of industries in the Netherlands.

The SIR-regulations mainly apply to the provinces of Zuid-Holland, Utrecht, (a part of) Noord-Holland and (a part of) Gelderland. Since its introduction in 1975, there have been several changes in this system in order to obtain a better harmony with physical planning experiences and economic developments (the recession, e.g.).

The financial measures of this system are usually taxes levied on the construction costs of the investments (varying between 8 to 15 percent of construction costs). Public buildings and agricultural buildings are excluded, as well as new investments in rehabilitation areas in some cities (Rotterdam, Schiedam and Vlaardingen, e.g.) and replacement investments in rehabilitation areas. Beside the financial means, there is also a related system of permissions and prohibitions in some areas (mainly the Rijnmond area near Rotterdam).

Investments are - in the framework of the SIR-system - judged on the basis of:

- locational and residential concentrations in the area at hand :
  - . the spatial and locational impacts of the investment concerned
  - . the necessary infrastructural provisions
  - . the consequences for the residential areas and the population
  - . the consequences for the natural landscape.
- the consequences for the labour market:
  - . structure and nature of demand in relation to supply.
- the economic structure in the area concerned:
  - . contribution of the project to regional diversification
  - . the impact on related economic activities.

The WIR-system serves at furthering the economic development, taking into account the abovementioned notion of selective growth. It is mainly a financial instrument based on investment subsidies. The basic premium for normal investments is 23% of the costs of new equipement (including the costs of land and of SIR-taxes).
In addition, a whole set of extra subsidies does exist, such as small-scale subsidies (up to 6 percent), physical planning subsidies (varying from 7.5 to 15 percent), spatial regional subsidies (ranging from 10 to 20 percent), and subsidies for large-scale projects. The physical planning subsidies are especially developed for a selective spatial development, in particular for a relocation from a SIR-area to a new growth centre (such as Alkmaar, Groningen, Zoetermeer, Nieuwegein, and Spijkenisse).

Both systems can be used in combination, and aim at obtaining a more balanced spatial and economic structure of the country.

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