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European Landscape Theory Course

Module Two: Issues in Contemporary Landscape Theory

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Systems Analysis and Landscape Planning

Abstract

Systems analysis is used to understand different processes and the relationships between relevant factors within those processes. Dividing complex problem situations into their basic elements allows for more specific and accurate solutions in planning. In principle, one can distinguish between two different kinds of systems analysis, hard systems analysis (operation research) and soft systems analysis with conceptual models. Systems analysis is a tool for improving the efficiency of the planning process by helping landscape planners to find a clear structure and to make this structure visible to others.

Introduction

Our world is subject to constant and ever accelerating change. Land use planning such as landscape planning is becoming more and more complicated. What was adequate up until now, will not be enough in the future. The landscape profession is challenged: to plan more and better. This means finding or adapting tools to incorporate knowledge and procedures into the planning process. I have used systems analysis in landscape research (see literature) and found that is was useful, helping me in organizing my thoughts and to find a mutual base for understanding and discussions with colleagues and professionals from other scientific disciplines.

My intention is to bring more of systems analysis into our planning courses at Alnarp, in particular because I have observed that it is rarely used among practising landscape architects and landscape planners.

I will try to give a general overview of the possible benefits and limitations of systems analysis. This paper is structured into the following parts: hard system analysis, soft systems analysis, hard systems analysis versus soft system analysis, the common elements of hard and soft systems analysis, integrating systems analysis with landscape planning and a conclusion.

Hard systems analysis

Hard systems analysis became increasingly important as computers were made accessible to the wider public. Military and strategic planners have been using hard systems analysis or operations research since the end of the 1950s. It was later applied to other problems as well. The ”limits to growth” (Meadows, Forrester et. al, 1972) report, predicting a shortage of the Earth’s resources within a period of few decades was based on hard systems analysis.
Since the 1970s, hard systems analysis has been widely used, mainly within the natural sciences, but also in social sciences. Hard systems analysis gives more information about the temporal and spatial behaviour of certain processes under given conditions (= systems). Relationships and interdependence of certain factors of influence which the system designer regards as most important, are described in a mathematical form. Analysing the processes’ behaviour in the past therefore makes it possible to predict the future by interpolating in the mathematical model.
The basic problem with applying hard systems analysis in planning is that a myriad of processes with different time scales covering different spatial units are in progress simultaneously. It is difficult to get an overall impression if the time intervals or spatial units of the systems are too different. Hard systems analysis can therefore only provide a reductionistic view of a much more complicated whole. Factors outside the model are regarded as constants. Model results have to be modified when new factors of influence come to be regarded as important.

Soft system analysis

Soft systems analysis and conceptual models are used to give a better understanding of complex interrelations. It is applied in situations where a) it is not (yet) possible to describe a process in a formal mathematical way, due to the amount of variables within the system and b) one is confronted with irrational factors, for example, political processes.
Soft systems analysis makes problem identification easier. What factors are relevant to the problem? How do these factors behave, how do they influence each other? There are several different approaches in soft systems analysis. A conceptual model is one of them. It may be the starting point of a planning process and may lead to a more detailed analysis, both in a qualitative and quantitative way.
After a detailed analysis, the planner might face another situation: what to do about the problem? Peter Checkland developed a ”soft systems methodology” for management purposes. He identifies client, actor, transition process, world-view, owner of problem and (social) environment. This can make a plan operational and suggest action in a certain direction and give responsibilities to relevant persons.
Many existing methodologies within landscape planning could also be regarded as soft systems analysis, despite the authors’ not being explicitly aware of this fact.

Hard systems analysis versus soft systems analysis

Systems analysis adapted for special purposes is used by many scientific disciplines. The methodological range is very wide. In many professions, it was common to apply systems analysis in a limited scope, focusing on specific tasks. Therefore it is not surprising that the term ”system” is given a different meaning depending on the interpreter’s background.

Because of this, I realised that quite often there is a lack of understanding between proponents of hard and soft systems analysis. The most obvious differences and frequent points of conflict are:

- technical or contextual: hard systems analysis is based on technical rationality, while soft systems analysis is based on contextual reality
- reductionistic or holistic: hard systems analysis singles out a certain process and analyses the factors within this process; soft systems analysis relates the same process to a larger and more comprehensive context
- quantitative or qualitative: hard systems analysis is based on quantitative research while soft systems analysis is based on qualitative investigations
- precise or plausible: hard systems analysis is formal and strict, processes are divided into certain time sequences and related to certain locations; soft systems analysis makes general judgements of relations between factors based on individual experience and perception
- charts or pictures: hard systems analysis visualises the behaviour of isolated factors in charts, while soft systems analysis draws pictures of situations
- expert or public access: hard systems analysis is not accessible to all people, because only experts can understand the terms; soft systems analysis is understandable to a reasonably informed general public

Table 1: Basic differences between hard and soft systems analysis

Basic differences	**Hard Systems Analysis**	**Soft Systems Analysis**
rationality	technical	contextual
world-view	partial	holistic
methodology	quantitative	qualitative
procedure	operational	conceptional
visuals	charts	picture
general access	experts	public

The common elements of hard and soft systems analysis

At the same time both hard and soft systems analysis have much in common and one can regard them as two different ways to achieve the same goal. The most obvious common elements are:

- aim: to support a decision-making process
- output: models; models are simplifications of reality, regardless of methodology
- input: in both hard and soft systems analysis, humans stand behind their models and their understanding is limited; the outcome is predetermined by their professional or cultural background
- planning tool: systems analysis makes it possible to find alternative solutions to problems in situations where there is uncertainty about the behaviour of various parameters
- communication tool: systems analysis is a means for understanding. It clarifies the points of discussion, which factors the counterpart is considering, how and why to set priorities; thereby systems analysis makes negotiation processes easier

Table 2: Basic common elements of hard and soft systems analysis

Basic commons	**Hard Systems Analysis**	**Soft Systems Analysis**

aim	decision making process
output	models = simplifications of the reality
input	model input comes from human beings
planning tool	enables alternative problem solutions to be found
communication tool	faciliates process understanding and priority rankings

Integrating systems analysis with landscape planning

Landscape architects or physical planners are mainly confronted with two different kinds of projects: those attempting to give an overview and others that focus on especially interesting objects. The result of the project approach is either a general plan or a detailed plan. For many planning tasks the synopsis level is sufficient, while other tasks need in-depth studies. If I were to use systems analysis this would mean: most jobs are sufficiently elaborated with soft systems analysis, but several strategic questions need a more precise elaboration with hard systems analysis in order to identify an adequate design and suitable measures within the final plan.

The planning process is not a straight-forward one. Systems analysis allows for the incorporation of various fields of expertise and public concerns into the planning process and makes mistakes in logic obvious. This means that the integrated systems analysis will force a plan to be revised and improved until it stands up to major criticism and fits in with society. It is a mix of technical and political inputs which contributes to developing the state of the art ”planning process”.

Conclusion

I have realised that the time needed to find acceptable planning alternatives becomes shorter with the help of systems analysis. My explanation for this is the following: systems analysis cannot achieve miracles or make planning any better by itself. The procedure to evaluate factors within systems analysis, the decision when to switch from the overview to the detailed level, and back, is the crucial issue within planning and can not be provided by an instrument. This remains the main responsibility of the planner and will continue to depend on individual experience and skills. But, systems analysis is an organisation and information tool which can increase our individual capacities to accumulate facts and to think deeper, at least at some stages of the planning process. We can also communicate the results faster in a more discerning way.

Appendix: Literature for further reading max. 50 pages

Checkland P. (1989). Soft systems methodology. In ”rational analysis for a problematic world” edt. J. Rosenhead. pp. 78 - 99.

Shaw R., G. Gallopin, P. Weaver and S. Öberg (1992). Sustainable development: a system approach. IIASA Status Report SR-92-6. pp 4 - 10 and 27.

Clark W. C. (1986). Toward a general understanding. In chap. 1 of ”sustainable development of the biosphere”. IIASA. Laxenburg. Austria. pp. 33 - 38.

Holling C. S. (1990). Integrating sciences for sustainable development. In ”sustainable development, science and policy”. Bergen 8-12 May 1990. Norwegian Research Council for Science and the Humanities. pp 359 - 370.

Own reference works concerning ”integrating systems analysis with landscape planning”

Breiling M. (1994). Emergency air protection: implementing smog alarm systems in Central and Eastern Europe. IIASA status report SR-94-01 Laxenburg, Austria. 54 pages. 3 page summary planned.

Breiling M. (1993). Future environments in peripheral Alpine areas - the case study of Hermagor district (in german). PhD thesis, Institut f. Landschaftsgestaltung, Boku Wien. 3 page summary planned.

Case studies referring to the author's experience with "systems analysis and landscape planning"

In the following I will analyse two of my major projects, both of them covering several years of my previous research and I will explain in what way systems analysis was used. In both cases the combination of hard and soft systems analysis turned out to be useful. The purpose was not to apply the methodology, but to improove the information base for local planning: a) to link local landscape planning with exogenous large scale impact factors and b) to compare different local planning approaches relative to each other. Thereby an overview will be conducted. The reference areas were in both cases specific landscape units, which were considered to be the suitable arena for local planning processes, covering an area of some 100 up to 2000 km^2. In the first project a scarcely populated periphere rural landscape is in focus, while in the second case densely populated urban areas are objected. Thereby systems analysis supports the translation of abstract problem situations to locally relevant and easy to understand information. The communication between people participating in local planning processes becomes thereby more easy. The relevance of new arguments becomes apparent and can enrich the search for suitable plan alternatives.

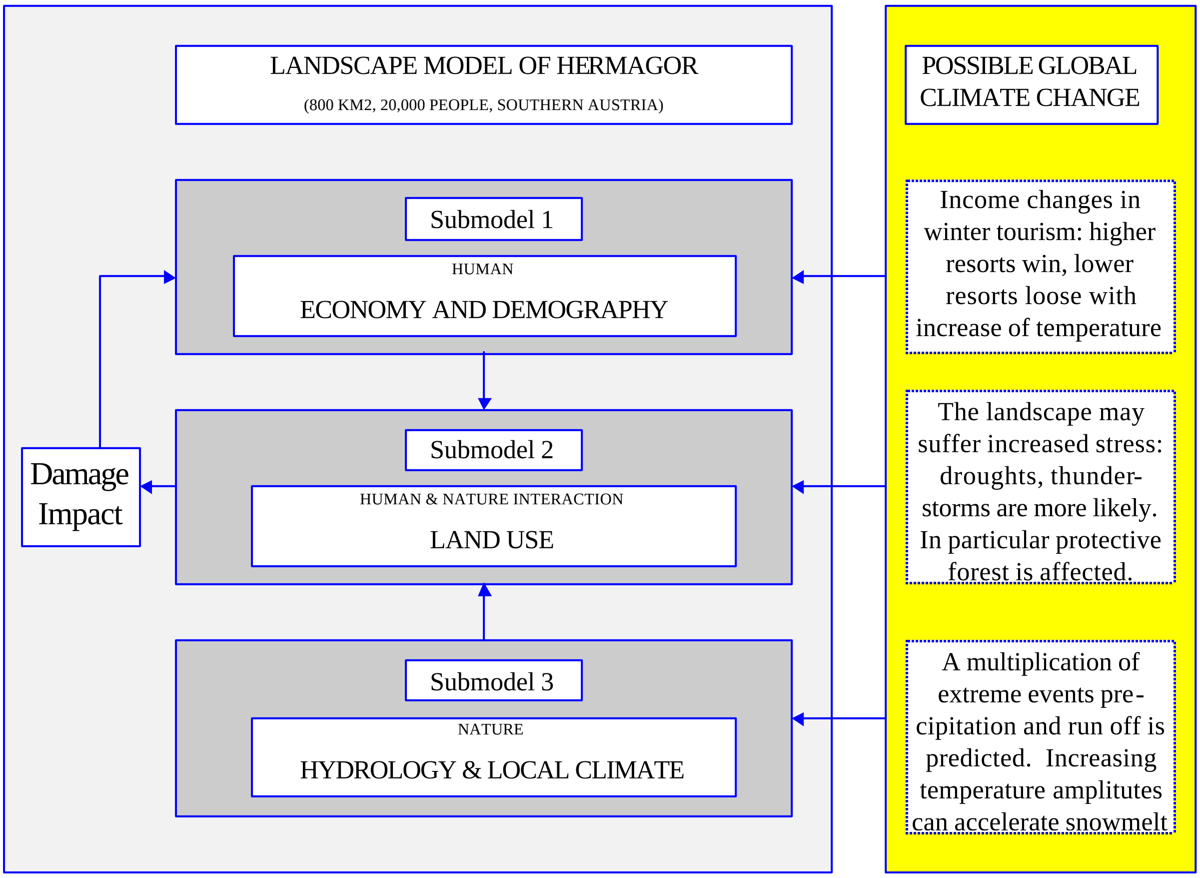
Project 1:
Future Environments in Periphere Alpine Areas - The Case of Hermagor District
key words: sustainable development, climatic change, systems analysis, regional landscape planning
Objectives of the project were to analyse the various developments in space and time of economic branches and the environment in general by data collected from Hermagor district according to communities from the period 1951 to 1991, and to give forecasts of the future short term situations to see if development is on a sustainaible path.
Three submodels describe a model of Hermagor district:
1) the state of economy by a demographic model "population according economic sectors",
2) the interaction of economy and environment by the "landuse" model,
3) the state of environment by a "hydrology" model.
The models assume that there is no exogenous influence affecting the local forecasts of the area.
However, global climatic change, is supposed to show serious consequences such as the increase of the frequency of catastrophies as well as their impacts or an increase in the unemployment caused by a decrease of wintertourism.
The results are preliminary. The land-use model does not give prognosis values yet and both other models should be improoved to gain better results[1].

Methodological research comment:

A conceptual local model was the origin. The idea was to built up mathemathical modules which should be linked to one operational model. Thereby the initial conceptual model (soft systems analysis) should be substituted by a mathematical model (hard systems analysis). Having a mathematical model on the local scale, it could be linked to global and regional models (climate change or regional acididification) and thereby evaluate locally the results of those models.

[1]This was done for the submodel "population according economic sectors" (Breiling, Charamza 1994)

FIGURE 1: A CONCEPTUAL MODEL OF HOW TO INCLUDE A GLOBAL IMPACT FACTOR INTO LOCAL PLANNING PROCESSES OF AN ALPINE DISTRICT



The first task was to find appropriate local data. These data was dispersed in many different institutes. Some data was free available for research purposes (hydrological data, demografic data), while other data had to be purchased (land survey, metereology). Other data was transformed from the available sources of the litterature (e.g. local income, impact of warming). On base of all available data a selection of useful data was undertaken.

The second task was to use these data for mathematical modelling, e.g. to explain processes due to the relation of the data at different time steps[2]. It turned out that certain modules were relative more easy to transform into mathematical formula than others. The local model could be finished for (1) population according economic sectors and model runs of possible future developments became possible (Breiling, Charamza 1994), but a lot of additional modelling work would be required to come up with satisfying results in (2) the local land use model and (3) an improoved version of the hydrological model. However incomplete the overall local model in mathematical terms was (no link between submodels = damage impact), improoved concepts of how to manage a global change issue locally derived from the modelling exercise. This in turn would allow a more sophisticated mathematical approach later on.

[2]In most projects data is used to give historical pictures of certain situations. This is a valuable method by itself, but it does not inform about the process dynamics.

Project 2:

Emergency air protection[3]: smog alarm systems in Central and Eastern Europe.

key words: emergency environmental protection, air pollution abatement[4], systems analysis, regional landscape planning

Emission rates are much higher in Central and Eastern Europe (CEE) than in Western Europe, making occurrences of air pollution episodes - smog - much more likely in CEE countries. The health risk is very high. A tool is needed to combat the situation. Smog alarm systems must be established if emergency air protection is to be provided. To achieve well designed smog alarm systems throughout the CEE region three steps seem to be necessary:

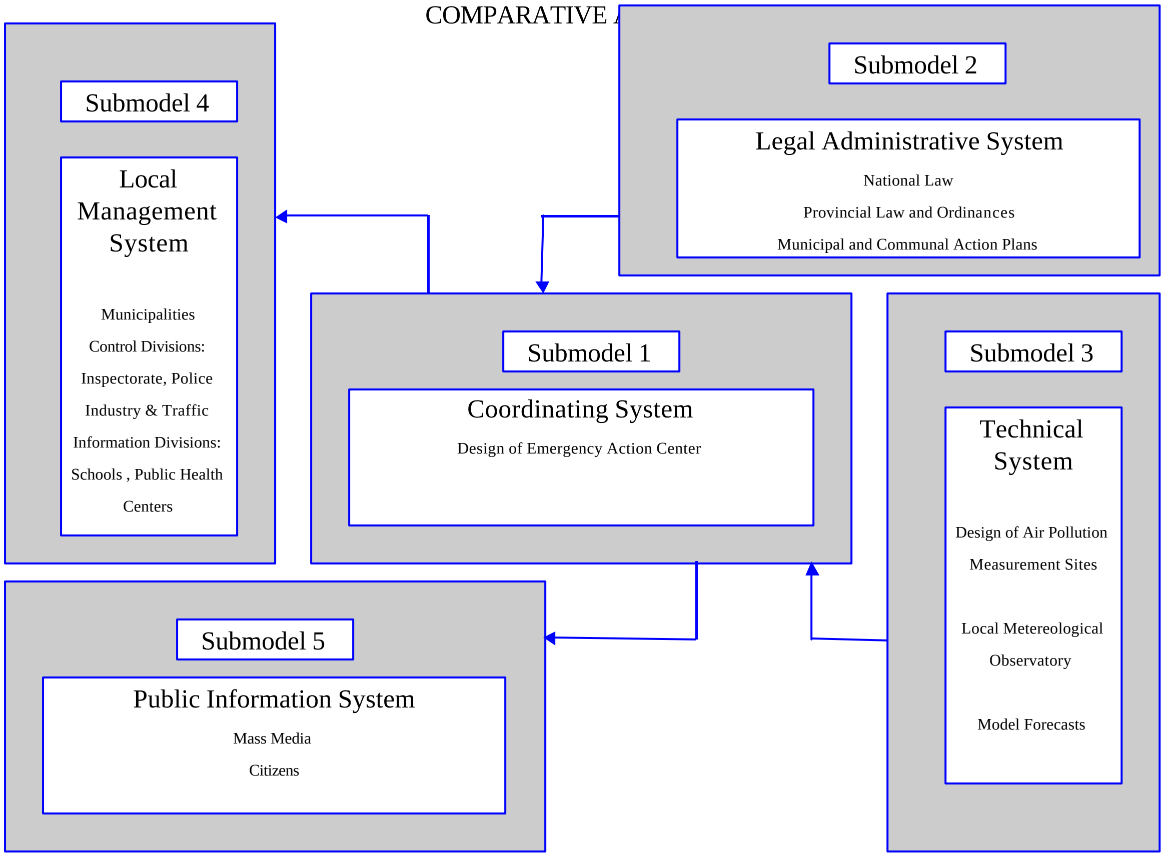
1) to get experience and information from existing systems in the West,

2) to bring this information actively to three selected CEE cities, and

3) to faciliate the implementation process

The scientific background (1) was provided by analyzing institutional and technical issues of smog alarm systems in 19 smog areas in eight Western countries (Breiling, Alcamo 1992). The information task (2) was in assisting the three selected cities Bratislava, Budapest and Cracow currently involved in setting up of smog alarm systems, to find the best possible design for them, and finally (3) to encourage other cities and smog areas within the CEE region to establish their own smog alarm systems by initiating a large scale implementation process.

FIGURE 2: A CONCEPTUAL MODEL TO SPLIT SMOG ALARM SYSTEMS INTO SUBSYSTEMS TO ENABLE COMPARATIVE A



[3]Several thousand people died during episodes in the 1950s in London (winter type smog) and Los Angeles (summer time smog) and many more were injured.

Methodological research comment:

The first task was to get information and data about the surveyed smog alarm areas. Questionnaires were sent out. After their evaluation, ten out of the 19 areas to be compared were visited, people in charge with the topic were interviewed and available reports collected. Additional information about the remaining areas was obtained by mail and telephone communication.

A properly functioning smog alarm system required planning and management from various different fields and professions. The problem situation was confusing. Dealing with the overall smog alarm system did not allow a specific task analysis to provide Central and Eastern European countries with particular advice for the design of their systems. Therefore different elements of the smog alarm system were structured in five subsystems and single issues were filtered out.

The five subsystems require an appropriate methodological approach. While the technical subsystem (3) depends on hard systems analysis[5], the legal and administrative provision (2), the local management (4) and public information subsystem (5) are based on soft systems analysis[6]. The emergency action center (1) has to combine and to coordinate all subsystems.

The modelling exercises brought many insights about the phenomenon smog. The integration of the societal impacts and the likely feed back reactions were highly important for the practical use[7]. In some other cases smog alarm systems seemed to be primarily designed for political reasons[8].

The analysis of the local areas with their smog alarm system and subsystems proved that all areas focusing too much on technical issues (dominance of hard systems analysis) or on political and administrative issues (dominance of soft systems analysis) had limited use in practice. The most successful smog alarm systems gave approximately equal importance to the hard and soft sided subsystems.

Conclusion

Inspite the two presented projects were different they led me to an analogous conclusion: efforts to use systems analysis in landscape planning helped to find and improve a structure for my projects and to communicate the results to local people involved who will use the results after I have completet my task in the planning process. Conceptual and mathematical models complement each other. If applied in combination soft and hard systems analysis can increase the overall quality of local planning.

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[4]SO_2, NO_x, suspended particulate matter, CO in winter and O_3 in summer

[5]These were mathemathical pollution forecast models on base of air pollution data, metereological data, collected every 30 minutes, emission inventories, landscape information data and others. These models were available and had not to be constructed (as in project 1).

[6]Here the soft system approach of Peter Checkland can be applied to optimise the management for each subsystem

[7]The city of Cracow had developed a remarkable winter smog forecast model, but this model could not be used due to a lacking legislation. The same applies for most Western European countries in the case of summer smog. They can not regulate O_3 in summer because major interrest groups are opposing such a regulation.

[8]In Milano frequent smog pre-alarms enforced measures only on Saturdays. The Vienna winter smog law had no practical effect, but relieved Vienna from some financial burdens to maintain the measurement network. In Austria - the forerider country in Europe concerning summer smog - a summer smog law was approved in 1993 without any measures.

Litterature for an in depth study:

Breiling, M. (1993). Die zukünftige Umwelt- und Wirtschaftsituation peripherer alpiner Gebiete. PhD thesis, Institut für Landschaftsgestaltung, Universität für Bodenkultur, April 1993, Wien.

Breiling M., P. Charamza (1994). Localising the threats due to global climate change in mountain environment. Proceedings of ProClim Conference. Davos. In ”Mountain Environments in Changing Climates” edt. M. Beniston, Routledge, October 1994

Breiling M. (1993). "Emergency environmental protection: implementing smog alarm systems in Central and Eastern Europe" IIASA final report, Nov. 1993.

Breiling M., J. Alcamo (1992). Emergency air protection: a survey of smog alarm systems. IIASA WP-92-52, August 1992, Laxenburg, Austria.