Basic Concepts and Prototypes of a Land Usage Design and Decision Support System

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ABSTRACT

This paper presents the basic ideas of a computer system for supporting urban design and decisions on land use. We argue, that the high complexity of urban design - inherent in the its large number of interdependent views and aspects - seems to justify a flexible support system capable of reasoning and conceptual modelling. Such a system may be prohibitively resource demanding unless we are able to build it up from smaller and larger modules of different types and functionality and which can be created basically in an incremental way without a complete plan in advance. Two prototypes concerning urban designs and a small flexible design rule interpreter/handler is presented for free standing buildings.

1. INTRODUCTION

Urban design in general is getting more and more complex around the end of this millennium. Some of the reasons are the higher environmental concern which requires sustainable developments; the tendency that the local community should have a larger influence on what is happening in their area (Tewdwr-Jones and Thomas 1998); negotiations about large projects and individual investments influence urban developments already in an early stage. In Eastern-Europe there is an additional serious problem: recycling of large, completely ‘worn-out’ areas became necessary by disciplined urban design and design control. The higher complexity of urban design is reflected not only in larger models, but completely different kind of thinking, finding of and reasoning with many alternatives, higher degree of incompleteness and uncertainty of data, conditions and requirements and higher flexibility in connection with future potentials or changes.

One way for local authorities to face the present higher demands for design control is choosing the right combination of alternatives from an appropriately large set of ideas and tools (Biddulph 1998). The choices may be on a more strategic level like being proactive and/or reactive, supporting commercial freedom and/or spatial plan, consultation and/or participation, normative concepts and/or contextual influence (Brehnens and Watson 1996); or more on a professional approach level like choosing typological approach and/or a problem solving approach (Luger and Stubblefield 1998, Lang 1994, Laurière 1990). The problem solving approach may include a large variety of generic models specialised, extended and/or combined to describe the initial knowledge about the problem. The need for a large tool set is emphasised by the fact that problem solving and increasing problem understanding usually run in an alternating way. This may be supported and strengthened by the declarative view of logic programming with a relatively straightforward Prolog implementation (Sterling and Shapiro 1994).

Quite a heated debate is going on in connection with the ‘planning theory-practice gap’ (Alexander 1997, Innes 1995, Forester, 1989). One can also try to analyse the result of a complex real urban design to gain and organise design knowledge (Galle and Kovács 1996) or solve a typical subproblem in a generic way with multiple solutions for adjustment to the context (Kovács and Galle 1994). In the present paper we outline a different approach: we work through prototypes based on real urban design cases elaborated by the second author and his colleagues. Further prototypes and/or support modules are being developed, which represent more the methodological side, but they are also used in connection with the case studies. A third group of prototypes is based on theoretical knowledge or results which we try to keep general , but they are also specialised from time to time for the actual need. A part of this specialisation and/or tuning can be made automatically. The incremental systems development methodology and perhaps even certain elements of a flexible floor plan design methodology (Kovács 1991, 1992) can be transferred to space planning on sites or even larger urban units by analogy on adjacency, functionality of space, internal traffic, etc. So we hope, that once we can get to a different conclusion than (Bolan, 1980): “There is also concern that the distance between planning theory and practice is not so much a ‘gap’, but a chasm”.

It is quite natural to think about more computer support for the increased complexity and difficulty of the tasks. There are several commercial computer systems for land use and urban planning, capable of handling and visualising a large amount of data in a Geographical Information System (GIS), e. g. MapInfo, ArcInfo. Other systems (e.g. ArchiCad, CorelCad, AutoCad) visualise architectural- or engineering processes often in great details including rendering and many other functionality according to the instruction of the user.

In this paper we present ideas, models and prototypes for another type of design and decision support which may be described as *assistance* in conceptual modelling, problem-solving, conflict resolution and decision making. Convenient, powerful and flexible support of these activities require substantial automatic and interactive reasoning, concepts, relations and processes close to human ways of thinking and easy incremental modelling capabilities. Another aspect of this assistance is the handling of alternative rules, methods or other model elements selecting matching ones and providing (in principle) all alternative combinations and solutions. Appropriate filters and samplers should reduce this potentially large number of solutions to a reasonably small, but substantially different ones.

Section 2 of the paper is devoted to a short description of the type of main task we are working with, including the planning unit, the involved aspects, the process of planning and some thoughts on why and how some ‘assistant type’ of computer support would be adequate. Section 3 presents a simple architecture, some of the elements and the a way of building up such a system. Section 4 contains a short account of two experiments, one of them is of a case study type. The other one is a methodological prototype covering some basic definitions and relations used in descriptions of LSU, including basic and secondary parameters used in design control. In the following two sections we present a small design module, which can be used to handle some design rules rather flexibly. Later it may be extended to handle other types of rules and it can be combined with other support system elements. Section 5 describes a set of rules for the location of the building on a site with a free single free standing building with the intended usage of a module capable of handling these rules. Section 6 contains an account on the flexibility of problem-solving and the present limitations of extendibility for more general types of design rules. Finally present and future meta-system functionality are discussed and a short note suggests a way of extending the methodology for more general design rules.

2. COMPLEXITY OF URBAN PLANNING

The high complexity of urban planning is due to the many mutually dependent aspects, views, activities, processes and interests which are handled and negotiated by different authorities, professional groups and influenced by many individuals, groups of people and a large variety of factors. The plan itself effects the quality of our life directly and indirectly in many ways, including social, economical, environmental, physical and non-material aspects for a long period of time. Our main view in the present article is the detailed urban regulating plan, particularly the land use and space planning, but it is inseparably connected to many other dimensions.

2.1 **The aim and purpose of the local plan (LP)**

The LP expresses the urban design of an area called local structural unit (LSU), which has the following four characteristics:

i) It has (now or after the planning) a relatively homogenous land use,
ii) It is generally confined by main roads
iii) The service facilities corresponding to its land use can be included in the area
iv) The functional organisation and built-up is unified

The aim and purpose of the LP is to determine the long-term land use of an LSU with strong considerations to the following aspects:

- Intentions and interests of the involved parties, namely the town and district communal authorities, land owners, investors and the inhabitant of that area
- Utilisation of the potentials of the area
- Support of a healthy natural, physical and built-in environment
- Cultural values
- Healthy and sustainable economic development
- The available resources, means and driving forces
- Dissolving or easing constraints and restrictions
- Compliance with the well-known or expected changes and movements not contradicting the previous views and aspects
- Conflict free transitions from present- to future land uses, flexibility toward adaptation of new elements, aspects or characteristics

The formulation of the LP should be sufficiently flexible in order to allow for desirable investments in a large variety of combination, while it should exclude the undesirable ones.

2.2 **The process of evolving a LP**

On the basis of the foregoing section, the main task of elaborating an LP is summarised shortly. It is given the initial state of an area to be (re)planned as an organic part of the town. The main task is to create a regulating system of indicators having the following properties. The regulating system should be characterised by a few main indicators and some parameters, the number of which depends on the size and complexity of the district. The number of parameters is typically between 10 and 100. The plan should be simple, clear, easy to understand and intelligible. It should comply with the master plan and reflect the relevant paragraphs of the general and specific town-, country-, and district regulations. It should allow for the desirable (intended) kinds of development of the area and exclude the undesirable (unintended) ones.

The development of a LP consists of a large number of activities which do not follow each other in a static and mechanistic order, but they are dynamically intertwined. This means, that one activity may have to be interrupted to get more details or more advances in another. In spite of this, the following short description of the LP process reflects the order in a certain degree.

The first step is an exploration of circumstances, conditions, constraints, criteria, potentials, etc. outlined in the foregoing section. This may be followed by a completion of the planning area in order to get an LSU. Then the global examination of the LSU is done with respect to the entire town / settlement and the surrounding LSU's including all of their mutual effects and other relationships. A natural next step is the examination of the different qualities and potentials of the LSU as a whole and of its individual sites from the point of view of suitability to certain land uses. Selecting the actual functionality (land uses) is a complicated process and beside individual suitability it requires careful analysis considering a large number of different views and aspects. Some of the most important ones:

- supporting- and side functions
- agreement, concordance and harmony between the land use within the LSU and in the neighbouring areas and the intentions of organisations and individuals involved
- availability of financial and other resources
- the necessary energy, traffic, public utilities, information networks

Having already an idea of the land use the reasonable alternatives of built-up types may be studied. Then area and space planning may include building forms and extensions, green areas, internal and external (vehicular and pedestrian) traffic with parking arrangements and other subareas. Creating the final LP means that the control of the LSU should be explicitly formulated in terms of regulations, which should be carefully examined if suitable for the purpose. In other words they are not too restrictive, flexible for future changes, but excluding undesirable developments.

The LP gets its final form consisting of three main parts. The first one is the preliminary examination. The program contains the land use, development plan, explanation and general plan. The regulations part include the general regulations, forming of sites, land use, position of buildings and other constructs, traffic, public utilities, environmental protection, green areas, general zoning and individual regulations.

It should be noted, that elaborating a new or a substantially modified LP is very often initiated by a single large investment proposal or a large project having a special image and attempting to harmonise several potential investments, which do not fit into the old framework. Often the master plan allows or even encourages changes in the town which are not adequately represented in the old LP. Then the urban planning and urban development are actually running in parallel with each other, a mutual communication and influence is inevitable. This also means, that the LP evolving process should often take into account existing potential investments otherwise fitting to the master plan, while maintaining the flexibility toward future changes or new potentials and keeping a harmony with the local environment.

2.3 **Computer support to the evolution of LP**

The aim of LP is to regulate land use in a long-term basis. But there are many mutually dependent factors, conditions, constraints and intentions which should be taken into account. Investigating them one at a time and solving the corresponding subproblems only ones would make the entire planning process rather inflexible. Furthermore several alternative ideas and solutions to the subroblems or postponed decisions in vital questions would increase the flexibility of the planning substantially.
But this would require a constant consultation between various experts and teams, as well as trying out many combinations of partial solutions of subproblems. This is very time consuming and demanding a large amount of human resources, thus it seems to be quite impossible. On the other hand, if we organise the most important parts of our present knowledge about the areas related to land use into relatively compact informal descriptions and formal logic, then we have a chance of getting a constant computer support maintaining the feasibility of our approaches, calling our attention to potential conflicts and getting other services for keeping many connections open.

3. DESIGN AND DECISION SUPPORT SYSTEM

One might say, that the complexity of the LP is very high and it requires deep and subtle human knowledge and experience, therefore a computer system will never be able to ‘take over’ this task. Trying to solve any of the substantial subproblems by computer seems to be equally hopeless, because of the many mutually dependent other problems. In other words only the whole of the LP development process is worth tackling by a computer system. Naturally nothing is wrong with the visualisation of a present- or a well-described future state, database search or any calculation according to a specified algorithm. But conceptual modelling or automating human thinking and reasoning is doomed to failure on this area, because of the high complexity, subtlety, missing knowledge / information and soft reasoning. Furthermore even a serious attempt to build such a computer system would require a long time and a large amount of human resources, before it can be used. So it would be outdated by the time it would be finished. Updating and further development would be equally demanding and hopeless. And the world around us is changing very quickly, including business and land use.

All these arguments seem to be correct as long as we imagine a kind of automatic computer system for the LP development process, which is controlled by a person using a full set of input data and appropriate parameter values to control the process within the frameworks provided by the computer system developers. On the other hand, if we imagine sovereign architects and other professionals working on LP development and the related problems as before - with full responsibility and creativity - they can still use conceptual models and limited reasoning assistance for several purposes. Some larger categories can be the following:

- Having access to the most vital rules presently applicable
- Checking basic obligatory rules of different types
- Saving and reusing elements and combination modes of typical cases
- Generating variants and prefiltering them according to basic rules
- Keeping track of some basic variants of the plans in a simplified, but useful way
- Having substantially simplified, but still non-trivial versions of mutually dependent problem areas would keep at least an overview of these relations

Next we suggest a few individual support modules that may be developed with a reasonable effort, without having a large system. Later we return to the question of systems architecture and the development of such system.

3.1 **Components of a design and decision support system**

When looking for single support modules in separation, we can think about activities which are relatively well defined and independent of other tasks. Taking it another way, a more complex task can perhaps be decomposed into dependent tasks, but overviewing and handling the dependencies require human intelligence. The main point is to find parts requiring substantial calculations, search, constructing-, evaluating- and fitting alternatives, using formal rules, etc.

Some examples of candidates for such support may be the following activities:

- Forming, composing, decomposing sites
- Area planning of sites, LSU s or their subareas, floor plan design
- Space planning including types and forms of building, morphology
- Appropriate land uses and functionality of buildings
- Collateral functions, buildings and area use to a main function
- Parking demand and selection of parking types, forming the parking area
- Internal traffic: road network, pedestrian pathways
- Checking environmental constraints, forming the green areas
- Characterising the permitted land use by main indicators and parameters

The idea is to select a few of the above activities to build experimental prototypes, which are gradually developed to be more and more comprehensive under development and constant use in real life problems. Two examples of this type will be shortly outline in Section 4 and a third one will be described in more detail in Sections 5 & 6. Other activities are also gradually included in this development as time and available resources permit and practice suggests. At the beginning relatively independent modules are built, which are supporting one main aspect of the town planning as done by the architect, who remains always the responsible initiator of all computer support runs in the real cases. The development of the system is a common effort of architects and computer system developers.

3.2 **System architecture and larger modules**

Now we come to the point of organising the modules such that they may have a limited communication, common work or combined problem solving power. Additionally there may be some general ideas, methods or services which are sufficiently general and therefore they may be used by several of the modules or even directly providing a kind of bridge from one module to another.

The ‘service’ category may include visualisation or communication to commercial graphics packages, database functionality, traditional calculation functionality, interfaces, natural language communication or textual search.

Another group of modules and functionality may be built up around the idea of networking. Any set of elements or objects may be arranged hierarchically for better access and more compact systems development. Particularly the object oriented paradigm and the notion of inheritance may contribute to clearness and compactness.
An alternative approach is to organise the elements or more complex objects into a non-hierarchical network, which can provide access ‘across’ the network from different starting points through different paths. Several different hierarchical networks on the same set of nodes may also be combined into a single network with advantage. Another version is called semantic network, because the nodes are connected by edges expressing a semantic relationship between the nodes connected. The semantic networks are particularly useful in reasoning when different areas are connected. Some types of edges may temporarily be switched on or off. This possibility can also be utilised when selected subjects or aspects should only be considered in a large network. The idea may be used to get more or less details within an area of interest.

Still another ways of organisations are the knowledge-based- and the expert systems architecture. The first one has more emphasis on knowledge elicitation and knowledge representation, while the second is more characteristically rule based. Both of them have certain additional functionality like explanation of reasoning, asking for missing data, rule or knowledge, decomposing problems and keeping track of the pending problems (blackboard architecture), etc. A particularly important aspect of such integration effort is the development of a special purpose language, which is convenient and natural on the area of application. The knowledge-based approach can add concept modelling to this approach, such that the words and expressions of the language have a high descriptive power, because the corresponding concepts and notions and some of their relationships are defined in the system.

It should be emphasised, that both the knowledge-based- and the expert system architecture can grow very large, but it is not necessarily so. One can keep a balance between developing immediately / individually useful modules and developing the background architecture to serve as a framework and connection between them as well as providing additional systems service mentioned above and many others. In a similar way we can keep a balance between immediate usefulness and general problem-description and problem-solving power. In order to ease the tension between these two kinds of effort, one can - in a relatively early stage - introduce a few very general and very powerful notions and relations, which start immediately working and serving both purposes. Gradual systems development principles and techniques make it possible, that the so-called rapid prototyping can be combined with regular systems development without extensive pre-planing and also without loss or extensive corrections of earlier versions.

4. COMPUTER SUPPORTED EXPERIMENTS

Throughout the years we have built up and experimented with a number of prototypes. Here we want to give a short account to see their interdependence and what we can learn from them.

4.1 **Analysis of a future bridge abutment area**

The purpose of the experiment was to get support in a variety of issues in the process of making a LP for this rather complex area having a large future potential and a rather mixed present usage. It contains several industrial subareas - many of them are out of use or working with a fraction of their capacity. Additionally, there is a residential area, a public bath, a service area and several green areas, one of them with an archaeological site yet unexplored. During the experiment we have created a number of verbal documents corresponding formal logic descriptions:

- General area description representing also the intentions of the involved parties
- The main components (sites) of the area, their qualities and relationships
- Formal logic description of the physical elements, their characteristics and relations
- Formal logic descriptions of the clients views, intentions and demands, as well as the types and categories of the objects
- Activities and their potential hindrances; predicates expressing general conflicts
- Prolog utilities making reasoning and graphical visualisation easier and more natural

Making this prototype and the experimentation with it was very useful and we could make a number of conclusions concerning knowledge representation, reasoning, visualisation and systems development. The most important aspects of the verbal texts were gradually and purposefully represented in formal logic. Then reasoning with the present and potential future land uses become possible in the extent the available facts, relations, requirements and intentions were represented. An automatic search for conflicts - mostly because of inappropriate environmental conditions, spatial restrictions or missing resources - became possible and visualisation of the results made it even more convenient to use. Naturally, regular usage of such support is only reasonable, if general computer support modules also become available . In the next section we shortly describe such a module.

4.2 **General categories and requirements for LSUs**

Taking departure from the definition given at the beginning of section 2.1 for LSU, we needed representations of several groups of concepts and some of their relationships.

On the top level, main land categories, land usage categories (zones), main road types and characterisations, resource and service system types are defined.
Then reasoning about buildings, sites conditions and constraints makes it necessary to represent subcategories, kind-of and part-whole relationships. Various view categories and the corresponding views are needed for moving between different areas of interests and finding mutual dependencies in general or in a context dependent way. The parameters describing the LSU are put into a hierarchic network with cross-references. This provides an opportunity to get the structured subset of parameters describing the present aspect(s) on the required level of details. Finally the definitions of the compound parameters in terms of the elementary ones are also represented, making the first steps into analysing the relationship between the various parameters and their confining effects in explicit and implicit constraints of the land use regulations. For example asking for main parameter categories and the corresponding parameters, we get the answers:

Main= density, Parameters=[utilization, ‘level area index’, ‘bioactive area index’],
Main= building, Parameters=[height, volume, ‘ground area’, ‘level area’], etc.

Considering a certain demand the relevant views may be obtained:

Demand= dwelling,
Views= [noiseless, ‘fresh air’, ‘clean neighbourhood’, separability, service,
‘own space’, security, relaxation],
Demand= ‘town centre’,
Views= [‘public institutions’, ‘multifunctional land use’, ‘multipersonal relations’,
‘large traffic’, ‘intensive land use’], etc.

When asking for a definition:

Parameter= ‘bioactive area index’
Def= ‘green area’/(paved area’+’built_in area’)

The answers of the support system may be used directly or the support system itself can use it for a variety of purposes, possibly in combination with several other reasoning elements.

The type of concrete LP analysis and planning outlined in the foregoing section can easily be combined with the general conceptual description of notions, attributes, relationships and definitions of the LSU discussed in this section.

5. PLANNING A SITE WITH A FREE STANDING BUILDING

This small module serves as an illustration for supporting space planning by using the rules for this type of arrangement. We indicate how this can be integrated more into other related activities. Then it will be shortly discussed how can the approach be extended to cover other arrangements.

5.1 **Basic rules for free standing building**

The module uses the following rules:

R1 *Minimum yard width (min_yard)*

The minimum width of the front-, back- and side-yards are 5, 6 and 3 meters respectively. The front-yard separates the building from a public area. The side-yard is facing toward another site with a free standing building and with a front-yard toward the same public area. The side of the building width neither front- nor side-yard should have a back-yard.

R2 *Number of levels (number_of_levels)*
The maximum number of levels is determined by the maximum height permitted on the building site and the height of a single level for the particular building use. (Several alternatives may be available as building use and corresponding level height.)

R3 *Yard width - building height ratio (yard_height)*
The width of the side-yard and back-yard should be at least H/2 and H respectively, where H is the maximum building height permitted for the site of this building.

R4 *Maximum building ground area (max_ground_area)*
The maximum of the building ground area can be determined by the maximum value of the built-up index permitted for the site. ('built-up index' = 'built-up area'/'site area')

R5 *Maximum building level area (max_level_area)*
The maximum of the total level area of the building can be determined by the maximum value of the level area index permitted for the site. ('level area index' = 'building level area'/'site area')

5.2 **The inteded usage of the module**

According to our original intention, this module should be able to check if a given free standing building satisfies the rules. In a (re)planning phase, when only the empty site is given with its regulating parameters, the module should be able to determine the largest size building and its location. As the location of the building is usually not completely determined, we might want to know a kind of characterisation of possible locations. Furthermore we expect, that when only partial information is given on the location and the size of the building and its potential use (functionality), then all the alternative solutions are suggested by the module. Here partial information means, that the present situation or some of the elements in the present planning variant may give some restrictions, but not necessarily determine completely the size and location of the building.

Given sufficient information, the module may select appropriate use or combination of different uses. We expect however, that supporting a selection of appropriate land / site / building use is much more reasonable, when several modules are available expressing many more facets of the question not only the few parameters included in the above five rules and built-up patterns other than free standing building can also be supported. Here it is only mentioned as an example for examination of the effects of regulating parameters. In fact, when a proper choice of such set of regulating parameters is desirable, the presently discussed module (and later other planning support modules) may assist in seeing the consequences of this or that choice.

6. IMPLEMENTATION AND EXPERIMENTATION

We have chosen some simplifications concerning the generality of the model of space planning according to strict rules. The purpose of simplifications was to get an implementation relatively quickly for experimenting, such that the basic architecture of the module remains simple yet extendible or even can be generalised if some of the elements are exchanged by more powerful ones. Concerning the intended functionality of the present module no substantial compromise was necessary.

6.1 **Simplifying assumptions**

Presently the strongest simplification is that the rules are applicable one at a time. In other words, it is not necessary to deal with more than one rule at any time. In general this is a very strong restriction and in Section ?? we shall outline a way of easing or even removing this assumption. For the ‘free standing building’ support module this assumption is almost true and it is easy to get around this difficulty and get the solutions in all cases (See Section 6.2) A related problem is that the rules are applied in a specific predetermined order. This order can be easily be changed or made context dependent as will be seen in Section ??. At the moment we assume, that both the site and the building are rectangular. Single rectangular buildings on reasonable polygonal sites can be handled similarly. Several separate buildings or composite (non-rectangular) buildings on a single site will require their own sets of additional rules.

6.2 **Flexibility and problem-solving power**

The formal logic descriptions of the system including definitions of concepts, attributes and relations, the rules, rule handling, etc. was written as a logic program and was implemented in Prolog. Handling of cases with full- partial- or no information at all were held together within the same logic description, which resulted in a very compact but logically clear descriptions. The core of the problem solving idea is a template describing the present building and a ‘freedom rectangle’, within which it can be moved. The program in all cases gives the largest possible building satisfying all the rules together with the largest possible ‘freedom rectangle’ within which it can be moved freely. If some or all of the data are known when calling the support module, then the largest building and freedom rectangle is given *within* the specified limits. For example the question

```
?-BuildSpace= [rect(Rx0, Ry0, Rx, Ry), build(Bx0, By0, Bz0, Bx, By, NLevels)],
   built_up(s30, free, Func, BuildSpace, BuildSpace2, _).
```

would generally result in several different answers (variations of fully instantiated BuildSpace2 templates), no matter weather all, some or none of the coordinates and sizes of the ‘freedom rectangle’ and the building are known in BuildSpace. The different answers are the consequences of alternative choices available for the system to accept or make maximum building sizes and floor levels within the specified context.

6.3 **Meta-system functionality**

The module ‘Free standing building’ design support is built into a presently simple, but extendible framework system.

For each of the design support modules databases and knowledge bases can be attached to find out which rules are applicable in a certain context. Then there is a rule interpreter, which applies the rules - possibly after checking some preconditions. Here extensions can easily be made for changing the rule order or to use additional knowledge for combining certain rules in various context dependent ways. When a system is selecting, preparing, changing, modifying, combining or otherwise manipulating another systems attributes, relations, methods, etc. then it is usually called meta-reasoning. This activity often requires second order logic.

The present framework already makes the coupling of modules possible in certain ways. For example one can use a database on available potential parking places. As a next step it can be substituted by a set of parking formation rules and/or patterns allowing for more freedom. On request new patterns or new pattern transforming rules may be generated by another module. But very likely, this generation of completely new elements need a rather direct control by the designer. A balance between flexibility and complexity should always be searched.

6.4 **Towards more integrated use of rules and regulations**

When some of the design rules and/or regulations for a site or LSU are so much dependent on each other, that applying them one at a time in any order is not appropriate, then we can use other approaches. One of them is a gradual satisfaction of the required conditions, going through the set of conditions or rules several times until all are satisfied. Another method is, when the rules are relatively precisely defined or they have at least such precise parts, then a set of algebraic conditions are defined and handled together with the logic conditions. This is called ‘constraint satisfaction’ within the logic programming framework. At present we use such an approach to make a design support system for a more complex site built-up type. Both of the approaches mentioned above should be initiated within and fitted into the natural framework of design, planning and decision making.

7. CONCLUSIONS

The high complexity of urban design and design control is due to the large number of interdependent views, aspects, factors and interested parties involved and its strong effect to the as yet unknown future. Therefore a very flexible and modular support system capable of reasoning and conceptual modelling seems to be important. The size and complexity of the estimated support system, as well as the ever changing demand suggests incremental systems development from very flexible multipurpose modules. It seems to be an advantage, if the basic objects, their attribute and relationships are well separated from problem descriptions, including rules, conditions, constraints and criteria. Again separate layers may contain the reasoning part and still other components would provide general systems functionality like explanation and management of as yet unsolved subproblems. Meta-systems capable of creating, modifying, specialising or adapting other systems should belong to still another layer.

In spite of the high complexity of urban planning, we can hope to find very basic relations and ways of reasoning which are general enough to be applicable on a large range of different levels. For example area planning in a building, on a site or on a LPU has certain basic common characteristics. Similarly design control, using main and secondary parameters in the three cases should have substantial similarities. We can find similarities in resource allocation, in environmental concerns, in vehicular and pedestrian traffic, storing, loading and transportation of goods, in the conditions and relations of different functionality (land use, building use), etc.

Our hope is, that theory and practice can benefit a lot from continuous communication and cooperation. The theory can gain very interesting challenging problems, tasks new views and a lively ground to test the resulting theories, principles, methods, strategies and techniques. Practice can gain unifying views, flexible methods, approaches, that are extendible and can be combined with other methods with advantage. A more systematic account on what is generally used or just an ad hoc modification. A thorough problem-solving approach may open new creative possibilities. If can be carefully combined with the local tradition. Last but not least conceptual modelling is not a only a way to more flexible or transportable systems, it is also a way of getting more self-knowledge and more possibilities to creative self development.

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