Delta•M
A Tool for Metropolitan Designing Systems

Aleksandra TISMA

Delta•M
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Proefschrift

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For my daughter Tijana

PREFACE AND ACKNOWLEDGMENT

The study of a computational tool for metropolitan designing systems grew out of my long-running fascination with computers and their potential for the improvement of both designing and decision making in spatial planning.

The first time I came into contact with personal computers was in 1988, when the Institute of Town Planning of Vojvodina, Novi Sad, where I worked at that time, introduced DOS PCs into the planning process. Although the software was complicated to use and limited in possibilities, I immediately realized the advantages that planners could obtain by using even such simple PCs. In 1990 my friend and I bought our first home computer, an Apple Macintosh which we used for the design of small-scale architectural and landscaping projects. So by to the time I arrived in the Netherlands in 1991 I already had considerable experience in using computers in urban design and planning.

The postgraduate education at the Faculty of Architecture, which I took from 1992 to 1994, offered me the possibility to explore the use of Geographic Information Systems (GIS) for the planning and design of 'new estates', areas on the border of cities, which combine urban and rural functions. The follow-up to this research was a project called "Cyberland" and then "Regio", both computer applications for educational purposes, which combine GIS and multimedia. In 1995 this was a hot topic among world scientists who were dealing with the implementation of GIS in spatial planning. That was also the time when I started discussion with my promotor, Prof. Dirk Frieling, about the theme of my future Ph.D. research.

Prof. Frieling has been professionally involved in spatial planning for many years, and from the outset his interest has been directed to experimentation with alternative methods for dealing with the spatial development of the Netherlands. Prof. Frieling's rich experience and knowledge concerning Dutch spatial planning practice, and my fascination with computers, for which he had deep understanding and support, resulted in the formulation of the theme of this research.

This research lasted from 1996 to 2000. During these four years Prof. Frieling and I have progressed together along the winding paths of this research, sometimes modifying it, making digressions, and then adjusting it to new situations, which was a necessary process given the recentness of the subject and the rapid development of technology in that period. As a very pragmatic and goal-oriented person, Prof. Frieling kept me 'on the ground' during this process, he kept me informed and involved in on-going projects related to the democratization of spatial decision making, and he was the one who suggested the theoretical background and the case studies of this research. In that respect he helped me greatly in learning about Dutch society and Dutch spatial planning. Professor Frieling was the one who forced me to start speaking Dutch, and I am grateful to him not only for that, but also for all I have learned from him in the seven-year period of our cooperation.

I would also like to express my gratitude to the examination committee: Prof. Dr. Ing. G. R. Teisman, Prof. M. M. Chanowski, Prof. dr. F. A. Lootsma, Prof. dr. P. Drewe, Prof. ir. C. J. M. Weeber, and Dr. ir. P. P. J. van Loon, whose advice helped me greatly to improve the content of this book.

This research also benefited a lot from the suggestions and guidance I received from Prof. Waltraud Gerhardt. Prof. Gerhardt taught me how to design the database of the prototype of the Delta•M DSS and she also pointed out some generic questions concerning the value of this research. I am most grateful to her for that.

I also wish to express my gratitude to Prof. Herman van Gunsteren, because reading his books and talking with him opened a whole new world of ideas to me.

The successful development of the prototype of the Delta•M DSS resulted from the very good collaboration with the Waterproof Company, and especially with Rene Luik and Victor Verstappen, who were pleasant to work with, supportive and who are still hosting my application.

Another person who helped me a lot with the 'computational' side of this research is Peter de Jong. I thank him for his willingness and efforts to help me in the testing and evaluation of the prototype.

Without the input of the inspiring projects of the students of the Delta•M etropolis design studio the prototype of the Delta•M DSS would be an 'empty shell'. So thank you all, and especially those who were so enthusiastic to complete their projects: Rogier van den Berg, Daan Zaanbelt, Benedict Kruis, Serge Schoemaker, Jarrik Ouburg, Meta Berghauser Pont, Bart Reuser, Marijn Schenk, and Maarten Piek.

I wish to thank all my colleagues and friends who took time to evaluate the prototype of the Delta•M DSS, the Association HMD, and especially Ria van Oostehout for providing me with the documentation for the case study. Many thanks to the secretaries of the Department for Urban Design, Linda van Keeken and Danielle Hellendoorn, for their administrative support.

Many thanks also to my English editor Mr. Marcus Richardson, and my Dutch editor Eva Bodor, who certainly improved the quality of this text.

Finally I would like to thank my partner in life and colleague in work, Predrag Sidjanin, for his support during the whole period of the research and help with the finalization of this, the greatest work project of my life.

Aleksandra Tisma
The Hague, July 2001

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Part one –

General introduction

1. Introduction

1.1 General goal of the research: A tool for designing systems

The goal of this research is to develop the *Delta•M Decision Support System (DSS)* as a tool that will help *designing systems* to jointly shape their metropolitan environments. The purpose of the tool is to improve the quality and speed of spatial decision making.

This research will involve the integration of theoretical knowledge originating from the theory of citizenship of van Gunsteren, Teisman's pluricentric decision making and electronic democracy; empirical knowledge gained through case studies, and advanced computational techniques. In their discourses, both van Gunsteren and Teisman do not consider practical means for the realization of their theories. The discourse remains on the level of an ideal or utopian situation. This research, however, looks at the possibilities that can be derived from the emerging techniques of computation and information communication technologies in order to provide a basis for the realization of van Gunsteren's and Teisman's ideas through a form of electronic democracy.

The research will result in the design of a *conceptual model* of the Delta•M DSS and a *prototype* application of a part of the conceptual model. The *conceptual model* will provide a complete description of the DSS so that thereafter it can be easily constructed and implemented in spatial planning practice. The computational aspect of the conceptual model will be provided by the combination of Object-Oriented Database System, Semantic Web and Liquid Technologies for data visualization. The Delta•M DSS will be developed for an open planning process and will be implemented via the Internet.

1.2 Context of the research and definition of key terms

This research starts with the premise that our physical environment is shaped not by the designs that architects and urban designers produce, but by the decisions about these designs. In the struggle between growing claims for space and maintenance of spatial quality and sustainability, the question is who should make those decisions?

Schön and Rein (1994) argue that 'design is a social process in which the action of design is distributed among multiple actors – designers, recipients of the designed object, and other stakeholders'. Schön and Rein further explain that once design is completed it is 'put into external context where the gallery of public opinion may change its meaning'. In this research, we advocate a design process in which this 'external context' is an actor in the planning process as well, and moreover on an equal level. We adopt the term 'designing system', which Schön and Rein define as 'a coalition of actors, individual or institutional'. However, instead of confronting the designing system with a 'larger environment' - in Schön's and Rein's opinion the larger environment consists of 'other' actors who see, interpret and react to the design - we consider the larger environment an inseparable part of the 'designing system'.

The 'designing system' is a temporary alliance of people responsible for decisions about the spatial development of an area, and it consists of public and private investors and citizens. Under 'public investors' we assume the authorities that are the major investor in the spatial development of the Netherlands. The private investors are all other non-governmental institutions, land owners, businesses and so forth, which also finance spatial projects to a great extent. Under 'area' we assume the territory of a spatial unit of differing scale under the terms of the Spatial Planning Act (*Wet Ruimtelijke Ordening*). It can be a part of a city, a city, a municipality, a part of a rural area, a region, a part of the country, or the country as a whole. The size of the designing system will depend on the scale of the plan under consideration, and we can assume that the larger the area, the larger the number of people involved in the designing system.

This research recognizes the ever-present existence of differences in visions of social developments, which constitutes the essence of democracy. We are also aware of differences in interests and levels of responsibilities (financial, legal, social) which different parts of society have. In that sense we do not deal with previously established ways of institutional and private actors' interaction in decision making, but we focus this research on citizen participation as an addition to that established system. In other words, this research recognizes that without the participation of 'powerful' actors no decision will be executed, and individual citizens cannot carry the financial risks that the powerful actors would. But this research also argues that the contemporary citizen of Dutch society seeks more direct ways to participate than those that the representative democracy allows.

The concept of citizen participation in a designing system in this research is related to van Gunsteren's (1998) theory of citizenship, in which neo-republican citizens who are members of today's western societies are competent enough to take part in the governing of their communities.

Another theory we introduce in relation to the designing system is Teisman's (1994) proposition of the pluricentric decision-making model, which sees the policy field as a network of mutually dependent actors through whose interaction goals and means are united in order to come to a decision.

This research also looks at the foundations and current experiences with electronic democracy – a democratic political system in which computer networks are used to carry out crucial functions of the democratic process such as information and communication, interest articulation and aggregation, and decision making (Hagen, 1996).

This research deals with the issue of spatial planning in the Netherlands. Spatial planning is a process that uses a variety of tools such as zoning, land use planning, transportation planning, environmental policy, housing programs and the like to achieve envisioned and desired goals within the natural and built environments. The term 'spatial plan' in this research is used as a general name for different kinds of plans, projects, designs, planning acts, policy documents (*nota's*) etc., and 'spatial planning' assumes the process of making and realizing those plans. In the later chapters, when we come to the details, we will draw a distinction between different plans, and explain their mutual relationships.

This research proposes the application of decision support systems in order to improve decision making in spatial planning. For this we define DSSs as computer systems able to assist decision-makers by analysing issues and proposing solutions on the individual level and providing interaction between the participants of a designing system on the collective level.

In this section we have explained only the key terms that are crucial to understand what will follow. There are also a number of other terms that will be used, and they are presented in the detailed list of terms at the end of this book.

1.3 Introduction to the problem definition: new methods of democracy?

Considering the current situation of western democratic systems, the question which many would pose is: Why do we need some other kind of democracy when we have already established routines that function satisfactorily, have their own laws, regulations and executive mechanisms, and most citizens do not complain about them?

The answer would be that although at first glance there are no mass complaints about the current democratic system, there are indications of dissatisfaction in all spheres of social life.

According to Frieling (1997), in the processes of individualization and the abandonment of old political concepts, established decision-making mechanisms are living their last moments. The time when political parties represented large social groups is behind us. Many scholars and professionals in spatial planning complain that decision making in representational political organs has become irrelevant, because they no longer communicate the wishes and priorities of citizens. Therefore we are seeking to re-invent the basis of the new democracy. Because, according to Frieling

(1997), " citizens have to re-take their political responsibility to liberate themselves from the ongoing bureaucratisation and juridification of society".

Van Gunsteren (1998) specifies the reasons why a new theory of citizenship is needed:

- The national society (nation-state) is no longer a self-evident context for political action and order. Externally it is related to competition with political entities such as the European Union, the World Trade Organization, the North Atlantic Treaty Organization, multinational firms and entities that are unnamed or illegal (e.g. the Mafia). Internally, powerful mass media, big money and the consumer society have fundamentally altered the traditional landscape of parliamentary democracy, political parties, and the rule of law, within which the position of citizen as voter and addressee of the nation-state was once secure.
- The status of the nation-state is changing from the dominant form of political organization to one form among many. The contours of nation states have become blurred in an international system that is multipolar and changing unpredictably.
- The pyramid model in politics based on the logic of rational and central rule is passé (Toulmin, 1992; Van Gunsteren, 1976).
- Sovereignty is divided and fragmented and has become an outdated concept.
- Politics and rule-making take place in diverse locations that are no longer connected to each other in a stable, hierarchical order.
- Citizens are frustrated with 'unresponsive leade-rship'; people ignore the messages that government send because they seem to be of little relevance to daily life.
- Citizenship has become plural – one person can be a citizen of several different communities (for exa-mple, the EU, Turkey and Amsterdam).

Teisman (2000) argues that the complexity of Western society expresses itself in organizational fragmentation, rapid economic change, and increasing and divergent preferences. The expectations and demands of citizens and organizations are rising. The quality of public policy products has to be increased in order to meet the preferences of society. Due to their monopolistic position, public organizations can resist turbulent changes in the market, but if they do not meet societal preferences, they will be confronted with a loss of legitimacy and support. To meet societal demands, the public sector has to continually improve the quality of its products. In such a society, Teisman claims, plans have a very short life span and new methods must be developed to generate strategic governance capacity.

The problems that are valid for policy forming and decision making in the general sense very much reflect on spatial planning and development. These will be specifically examined in the next section.

1.4 Problem definition: spatial decision making in the Netherlands

The Netherlands has a strong tradition in spatial planning and spatial development. Spatial development is regulated by the Spatial Planning Act (*Wet Ruimtelijke Ordening*, WRO), which defines the rules for the planning of every spatial unit, from the national to the municipal level. The consequence of this is that there is a huge amount of plans of all kinds – a national policy document on spatial planning, structure plans for policy sectors, regional, structure and master plans, local land use plans, and so forth. According to the Scientific Council for Governmental Policy (WRR, 1998), it is characteristic of the Dutch spatial planning system that it lacks means of power and its 'own' executive instruments. This means that adjustment occurs through consultations, convictions, and cooperation, which are laid down in extensive procedures. The result is that procedures for spatial plans take a long time and sometimes end up without satisfactory decisions.

Criticism of such a situation in spatial planning in the Netherlands is not new. It dates from the early 1990s, when the government itself acknowledged that there were weak points in the spatial planning system. These were first noticed in the planning of large infrastructure systems. According to the WRR (1994), the government blames very complex legislation and instructions for the bottleneck in decision making. Because of the accu-mulation of self-directed rules, an unmanageable whole emerges that diminishes the rationality of a spatial project under consideration. But the WRR points out that it is not just complex legislation and the involvement of many different instances that should be blamed for the time-consuming and inefficient procedures. The WRR discovered that a lot of problems stem from the manner in which large projects are approached. Namely, large projects are usually considered as technical issues, and in the first instance discussed down to the finest detail in a closed circle of professionals and government representatives. Only when the projects are practically completed are they exposed to socio-political discussion and then in a defensive manner. This causes opposition and delay in the approval of the plan. To resolve this, the WRR suggests that 'decentral parties' should be involved in the decision-making process at a much earlier stage.

According to the 'Land Water Environment Information Technology' Association (LWI[1], 2000), which supports new approaches in complex infrastructure works, when traditional methods of decision making are used, large infrastructure projects are becoming increasingly more problematic to implement[2]. These sorts of plans that are changing the space and environment often have to cope with resistance from the population and other stakeholders. The intensive countering of existing interests often leads to decisions being postponed, the decision process on the part of the government being paralysed, and an impatient and divided attitude on the part of companies and industry. The LWI claims that the current approaches for dealing with infrastructure projects are apparently not in keeping with the changed demands and interactions of this day and age. The challenge for new planning methods is to execute the necessary environmental changes without causing conflicts between governments, local authorities and civil parties. The LWI concludes that this demands other forms of planning and taking decisions.

Annual investments in the physical transformation of the Netherlands amount to some 60 to 70 billion guilders, with 80% being private and 20% public investment. This means that the market parties play an important role in the factual realization of spatial plans and projects, and so the influence of these parties in spatial planning and development is considerable.

1 www.lwi.nl

2 To give a few examples: the north branch of the A4 highway, the new rail route trough the "Betuwe", the second "Maasvlakte", the "Westerschelde" and the coastal expansion "Nieuw Holland".

According to van Middelkoop (1999[3]), problems in spatial planning are accumulating because the time when only the government had rights in spatial planning are over and in place of this a complex policy process - 'a play with a lot of players' - has come into existence. Van Middelkoop goes on to say that the multiple use of Article 19 of the Spatial Planning Act (WRO) is unsatisfactory and the spatial planning system is no longer shaped to follow the dynamics and complexity of spatial processes.

Because of the frequent changes in the WRO, the system of spatial planning has become ambiguous. In considerations about the fundamental revision of the WRO (www.minvrom.nl/minvrom/pagina.html?id+1199) a serious concern is expressed about the relationship between decision making about projects and spatial plans, because when only projects are decided upon the integrity of space will come under oppression. The implementation of a policy – i.e. how quickly a new state policy is transformed into local land use plans – is felt to be slow. According to the same sources, the WRO is not adjusted to the speed of the development of society.

The government has two roles in the arrangement of space in the Netherlands: planning and development. The main aim of planning is to provide the spatial conditions for balanced development. The task of planning is then to keep spatial claims balanced and to protect the common interests of the citizens of the country. In the development role, the government provides means for the realization of public services such as infrastructure and greenery.

In a small country such as the Netherlands, the task of spatial planning is an integral consideration in the claims for space originating from different parties. This, of course, cannot be achieved by allowing only citizens or only market parties to decide about spatial plans. Some form of governmental control certainly has to exist in order to protect the common and long-term interest of a sustainable society. But the question is whether this can only be solved through changes in the WRO.

3 van Middelkoop, E. Wijziging van de Wet op de Ruimtelijke Ordening, www.gpv.nl/nieuws/k990126.html

Frieling (1999)[4] names three reasons why learning to decide faster and better about large spatial investments is so pressing and urgent. The first reason is that Dutch decision-making processes are slow and disappointing, and often procedures have to be repeated (Frieling gives the examples of Betuwelijn and HSL-zuid). The second reason is that in the establishment of the European Union, competition is such that much faster reactions are required in order to keep up. The third reason is the necessity to increase efficiency and the effectiveness of public spatial investments.

All the above problems were the reasons for many initiatives to seek solutions and improve spatial decision making in the Netherlands. In the next section we will examine some of them.

1.5 A brief overview of recent attempts to solve the inefficiency of spatial decision making

Attempts to improve spatial decision making in the Netherlands have already been around for many years. They originate from government, scientists, theoreticians, professionals and combinations of these.

In 1994, aware of the problems of the time-consuming and inefficient procedures of spatial planning, the Dutch government asked the Scientific Council for Governmental Policy (WRR) for advice about the policy on large infrastructure projects. The advice was published in the WRR report 'Decisions about large projects'. In 1998 further advice was published by the WRR in the 'Spatial Development Policy' report. The first report proposes as a remedy the establishment of a new law which will only be implemented for decision making about large infrastructure projects. The law will combine different legislation methods to encompass both concentration and deconcentration in decision making. The second report states that "there is a need for an open form of planning, where society will be involved at the earliest possible stage". As a solution to the problem, the WRR suggests integral planning through various levels of spatial scale, from national to local, with special emphasis on integral planning at the regional level.

[4] Frieling, D. H. (1999): Sneller, beter beslissen. Openbaar bestuur, No. 5

On 23 February 2000, 35 years after the establishment of the Spatial Planning Act, Minister Pronk submitted a discussion policy document (*discussienota*) to the Parliament entitled 'On the Way Towards a New Spatial Policy Act (*Op weg naar een nieuwe wet ruimtelijke ordening*)'. This issue got top priority from the Ministry of Spatial Planning, Social Housing and Environment (VROM), and it is expected that by the end of 2002 the draft for a new Act will be complete. The new law is supposed to solve the problems mentioned in the previous section.

In his article about the changed relationship between government and society (NRC, July 1999), the Dutch Minister of Internal Affairs Mr. B. Peper proposed restructuring the political and governmental system in order to accommodate the influence of the individual citizen. He sees information communication technology (ICT) as one of the most important factors in the democratization of governmental functions.

Theoretical considerations about the reasons for a situation with citizens' involvement, models of decision making, and possibilities for new approaches to general policy-forming problems are expressed in the work of the scientists van Gunsteren, Teisman, in 't Veld and others. Their points will be examined extensively in Chapter 3.

The actions of professional spatial planners stem from the needs of planners to quickly and efficiently realize their design ideas, and avoid being limited by complicated legislative procedures. Professionals express their meaning through debates or discussions, such as the Metropolitan Debate (HMD), Give Me Some Room, the Internet discussion about the Masterplan Southaxis in Amsterdam, the referendum about the Ijburg project and so forth. In particular the action of the HMD contributes to the discussion about the arrangement of space in combination with new methods for decision making. This method will be described in detail in Chapter 4.

The most promising example of a combined multidisciplinary approach to the issue of spatial policy development and decision making was the approach of the LWI. According to the LWI, solutions for infrastructure problems demand a flexible attitude, clear starting points for all stakeholders and, above all, support and collaboration through an integral approach of complex infrastructure developments. In the period from 1994 to 2000, when the association was disbanded, the "Land Water Environment Technology" program developed many products[5] for supporting this new approach to decision-making processes in all sorts of fields concerning infrastructure developments in the Netherlands. The LWI, like others, developed ICT-tools, gave advice and created role-play games. The LWI operated as an objective intermediary of third party expertise and an independent facilitator for the realisation of tender consortia. The LWI's activities comprised a broad field of disciplines, varying from estuaries and coastlines, rivers and fresh water management, main ports, large-scale line infrastru-ctures, information and communication technology to interactive plan development.

Throughout all the above attempts to improve the quality and speed of spatial decision making, there are two points that are relevant for this research:

- Government, theoreticians and professionals alike propose an open planning process and the involvement of the market sector and citizens in spatial planning processes.
- Both government and professionals see the possibility for improvement in the emerging use of information communication technologies.

The above attempts, however, although having brought some improvements to a certain extent, have not yet substantially changed the existing routines in spatial decision making, and have not yet improved the quality of decisions and the speed of planning procedures.

1.6 Decision Support Systems as a possibility for the improvement of spatial decision making

The goal of this research is to develop a Decision Support System for designing systems. In examining the practice of the design of decision support systems for spatial planning purposes we could find a large number of examples of systems that are either too complex, too specialized, expert-oriented and therefore unsuitable for non-professionals, or systems that are too simple or too general, and therefore unreliable. Some decision support systems have been developed to support planning for specific tasks, such as facility locations, retailing and the like (Harris, 1989; Shiffer, 1992; Densham, 1996; Klosterman, 1997). Thus, although there are numerous DSSs already developed, most of them (and even those of the LWI who claim that it has an integrated approach) support only one aspect or a combination of a small number of aspects of spatial development.

The complete process of spatial decision making has not yet been covered by an integral DSS. The reasons for this may be that in the attempts to implement DSSs in spatial planning many scholars face difficulties because of the complex character of spatial issues. Not only that, spatial planning involves physical, economical, social and cultural aspects, which have an unstructured nature, and the planning processes are also dynamic and changeable in character.

The challenge of developing an overall useful DSS for spatial planning purposes lies in the successful integration of knowledge about spatial problems and solutions with computational and communicational technology in a coherent system, and then implementing that system both technically and institutionally. This research attempts to meet this challenge.

1.7 Research assumptions

The main research question of this thesis is:
How can we design an overall DSS which will, firstly, make the realization of the concept of a designing system possible, and secondly, will offer that designing system the possibility to improve the quality and efficiency of spatial decision making?

The main assumptions that will be explained through this research, related to the considerations of possibilities for the improvement of spatial decision making are as follows:

- *The quality and speed of spatial decision making will be improved by the formation of designing systems.*

[5] An extensive list of products can be seen on the LWI website, www.lwi.nl

- *Designing systems will be able to function on a large scale only if they are supported by Information Communication Technology integrated in an overall Decision Support System.*
- *The Delta•M DSS will provide an instrument for the operational realization of designing systems, by providing decision-making information, advice on choices on an individual level, and by improving the contact and interaction of the members of a designing system on the collective level.*

The claims made here are that the DSS that will be developed through this research will be applicable and adequate, and that it will perform in given circumstances better than some other alternative tools.

1.8 Framework and methods of the research

The central point of this research lies in the development of the conceptual model of the Delta•M DSS. To achieve that, an interdisciplinary research method is used in order to integrate theories, empirical knowledge and knowledge of computational science and information communication technology. The method is presented in Figure 1.1.

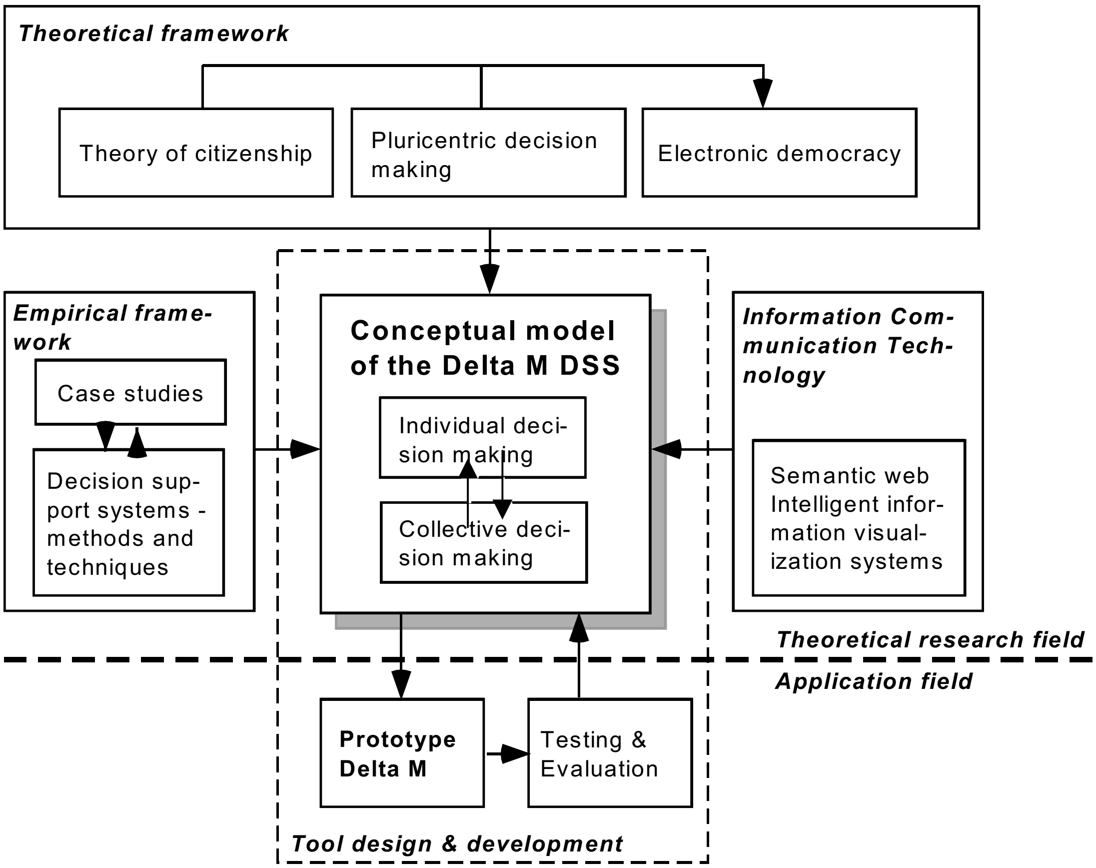

Figure 1.1 Overview of the research method

The research starts from knowledge arising from the theories of citizenship (van Gunsteren) and pluricentric decision-making (Teisman), and places it in relation to theories of electronic democracy. The theoretical framework will be used to formulate generic system requirements for the conceptual model of the Delta•M DSS.

Simultaneously, the empirical knowledge that was gained through the four examples from Dutch spatial planning practice, which comprised the case studies of this research, is used for the design of the database, interfaces and interaction tools of the Delta•M DSS. The techniques and methods originating from the development of other decision support and ICT systems are used for the development of the computational part of the Delta•M DSS.

When the conceptual model of the DSS was completed, the development of the prototype started. Adriole's nine-step prototyping method was used to develop part of the conceptual model. The prototype was tested according to the three-level testing methodology developed in this research. The results of the testing will be used for future improvements of the conceptual model.

Looking at Figure 1 we can see that this research covers several fields. In the field of theories, it uses theories to define the framework for the tool development. In the field of tool design and development it combines theoretical, empirical and computational knowledge in the conceptual model of the Delta•M, and in the application field it results in the first prototype of the part of the conceptual model which covers individual decision making.

1.9 Generic tool requirements

In order to achieve the goals of this research, we have to specifically express some requirements which would be necessary to be fulfilled by the design of the Delta•M DSS. This section presents only generic tool requirements, while requirements based on theories and empirical research will be specified in Chapters 2, 3 and 4.

The generic tool requirements are based on the needs to improve spatial decision making related to the introduction of a decision support system. These are very broadly defined as follows:
The Delta•M DSS should facilitate:

1. An open planning process, which assumes interaction between the members of a designing system.
2. A reliable planning process, which is legally sustainable and transparent to all the participants.
3. Adopting good decisions by improving the structure in the decision-making process (analysis of the assignment, inventarization of solutions, establishment of selection criteria, positioning of the decision-makers towards the other participants etc.)
4. Shortening of the time needed for decision-making by assisting individual decision-makers in their choices; by simplification of communication between the decision-makers; by giving better insight into the procedures; and by making them permanently accessible.

1.10 Constraints of the research

Although it is based on certain theoretical premises, the aim of this research is not to develop a new theory. This research is rather empirical, and directed to the practical development of a computational tool, which can be directly implemented in spatial planning practice and used by a ‘designing system’.

The success of the Delta•M DSS depends on social-political movements such as the decentralization and democratization of decision making. In this research we supposed that this will be the case, but we have no means to prove it, so we have to rely on a hypothetical situation.

The aim of this research is not to transform society and invent new methods for political decision making, but only to create an instrument – a tool – that will enable competent citizens to actively take part in public decision making, thus providing conditions for the realization of the ideas of pluricentricism and neo-republican citizenship. More specifically, the Delta•M DSS does not intend:

- to replace human judgement, but to reinforce it,
- to replace human contact by virtual contact, but to combine human networks with electronic networks, and
- to eliminate the influence of state and local governments in decision making, but to accompany them and provide a platform for an open planning process.

Although at some points this research tackles problems that arise from the weaknesses of current legal procedures, it is not focused on legal and juridical aspects, but rather on technical and organizational aspects of spatial decision making. Therefore it is not our intention here to deal with alternative solutions for legal procedures, but to propose a new tool which can facilitate some parts of current procedures, and which has the potential to support future restructured and more democratic ways of decision making.

The differences in the information needs that actors can have and the economical dimension of their decisions are not worked out in the conceptual model of the Delta•M DSS.

1.11 Outline of the research

This study has four main parts: *general introduction, theoretical background, empirical background, conceptual tool design and prototyping, and evaluation.*

Chapter 1: Introduction
At the beginning of this chapter we present the goal of the research and definitions of the main terms that will be used in this research. This chapter introduces the background of the research by explaining the problems in spatial planning that were the impulse to conduct this research. The review of possible solutions and specifically the approach of this thesis are explained. This chapter also explains the methodology, general assumptions, and constraints of this research.

Chapter 2: Citizens' participation in spatial decision making; the social context of Delta•M
The second chapter gives an overview of the social premises on which the model of the tool is developed. The ideal types of (political) decision making are described and the idea of neo-republican citizenship is presented. Both approaches to decision making are discussed in the framework of the latest developments in the field of electronic democracy.

Chapter 3: Review of Decision Support Systems in spatial planning
The third chapter addresses the subject of decision support systems in relation to spatial planning. Definitions, the theoretical background and the implementation of DSSs for spatial problems are discussed. The chapter explores the possibilities of decision support systems for the accommodation of the theories of citizenship, pluricentrism an electronic democracy. The chapter defines the requirements for the Delta•M DSS on the basis of the analysis of existing spatial DSSs.

Chapter 4: Case Studies
The fourth chapter deals with four examples from spatial planning practice: The Metropolitan Debate (HMD), Masterplan Zuidas Amsterdam, Deltametropolis and the Open Place projects. Each of the examples is separately described and analyzed, drawing conclusions which are later used for the development of the Delta•M DSS. Examples are also looked at as an indication of possible participation of citizens.

Chapter 5: Conceptual model of the Delta•M *DSS*
This chapter deals with the definition of system requirements and the development of the conceptual model of the Delta•M DSS. The structure of the system is presented and the content of the system's database is explained. The knowledge base and matching system are described and technologies for the realization of the conceptual model are specified.

Chapter 6: The prototype of the Delta•M *DSS*
Describes the prototyping method and implementation of this method in the development of the prototype of the Delta•M DSS. The form, data model and performance of the prototype are explained and the results of its testing and evaluation are presented.

Chapter 7: Evaluation
This chapter is devoted to the evaluation of both the conceptual model of the Delta•M DSS and the prototype of the part of the Delta•M DSS and their applicability.

Chapter 8: Conclusions
This chapter provides general reflections on the research assumptions and draws final conclusions on the applicability of this research related to technical aspects of the system design and the complexity of the social issues such as where or when it should be imbedded.

Part two –

Theoretical background

2. Citizens' participation in spatial decision making; the social context of Delta•M DSS

In this chapter we will explain the theoretical background which was the starting point in the conceptual development of the social program of the Delta•M DSS. The theories described are chosen because they are either directly or indirectly concerned with the involvement and position of citizens in policy forming and public decision making.

According to Frieling (1997), in the processes of individualization and the abandonment of old political concepts, established decision-making mechanisms are living their last moments. The time when political parties represented large social groups is behind us. Many scholars and professionals in spatial planning complain that decision making in representational political organs has become irrelevant, because they no longer communicate the wishes and priorities of citizens. Therefore we are seeking to re-invent the basis of the new democracy. Because, according Frieling (1997), " citizens have to take again their political responsibility to liberate themselves from the continuous bureaucratization and jurisdiction of the society".

Both pluricentric perspective and neo-republican theories yield an approach of how this re-establishment of new democracy might be realized.

We will start with the pluricentric perspective, a model of decision-making proposed by Teisman (1991, 1992, 1997, and 2000). The pluricentric perspective deals with the interaction of actors through networks, and policy making and steering in a multi-actor setting. In that sense, the pluricentric perspective examines the interaction between groups that represent or seek different solutions for policy problems.

The theory of the neo-republican citizen of van Gunsteren (1992, 1995, and 1998) is oriented more towards the individual citizen and his role in creating and managing the community of competent citizens.

We will also discuss the background and potentials of electronic democracy as a means to support the transformation of current decision-making models and provide a platform for the involvement of citizens in pluricentric form of decision making.

Finally, we will position our research in the theoretical framework and define the requirements for the Delta•M DSS which relate to the theoretical framework.

2.1 Perspectives on complex decision making

In his book "Complexe besluitvorming" (1992), Teisman analyzes and compares three approaches to complex decision making: unicentric, multicentric and pluricentric. He advocates the pluricentric perspective as the most appropriate for contemporary (network) society. On the basis of the pluricentric perspective, Teisman (2000) develops the CCC (concurrent, creative, competition) model for strategic management.

The pluricentric perspective is based on a critique of the other two perspectives on decision making - unicentric and multicentric. In the following chapters we will look at these three perspectives from the points of view of structural-organizational, policy forming, the nature of decision making and the distribution of means for decision making.

2.1.1 The unicentric perspective

In the unicentric perspective, the field of policy is hierarchically organized. In contrast to the private sector, which consists of a large number of autonomous organizations, the public sector is seen as a single organization. Within the organization tasks are divided between the actors on different levels, whose interaction is regulated through coordination (laws or planning).

The politicians at the top, chosen by the citizens, decide upon the desired collective goals and the means to reach those goals. The administration, including lower-level governmental agencies, help to formulate and implement the adopted policy. The policy-making freedom of the local government is subordinated to the national government.

Policy is formed and established by the central unit (for instance the government), which creates the steering program to serve the general interest. Decision making finds its place in subsequent phases of policy forming, policy establishment and policy execution.
Means (money and competencies) are seen as steering instruments and they are in the hands of the central unit.

2.1.2 The multicentric perspective

The policy field in the multicentric perspective consists of a union of the autonomous, independently trading local units. They form markets where they do business between themselves on the basis of exchange. The organization has to be arranged so that the market can operate as well as possible.

The policy of local units adapts to developments on the market so that it is able to cope with the competition of other units. The fulfillment of individual interests would serve the collective interest the best.
The concept of decision making is similar to that of the unicentric model, with the difference being that it occurs within the local units. These take decisions that will cumulatively lead to an optimal result.

Through the exchange of means (sources) between local units, the individual aim is fulfilled as well as possible. In the internal-organizational processes (thus within the local units) many unicentric instruments (such as planning and coordination) are used. The difference from the unicentric model is that the degree these instruments can reach is much more limited.

2.1.3 The pluricentric perspective

The pluricentric approach rejects the monolithic structure of government. The government is not seen as a single unit, but as an interwoven network of organizations. The government sector has an organizational principle, tasks are also divided, and there is a certain formal relationship between the actors in the public network. However, this does not mean that it is a hierarchy in every respect. The formal juridical hierarchy may exist, but means such as money, knowledge and legitimacy can be and often are divided in a non-hierarchical way.

In the pluricentric perspective, the policy field is structured as a network of mutually dependant actors. Policy is neither central nor local, but jointly formed through the interaction between the central and decentral actors. Decision making can be defined as a series of decisions about a specific issue, where phases or completeness are out of the picture.

The means are dispersed and in the hands of various actors, making the actors interdependent. For a decision to be made, the means of various actors have to be collected and united. This is only possible when the common interest of all the actors is a starting point for decision making and when a certain amount of policy freedom is obtained for all the actors.

Here it is important to emphasize the difference in the behavior of the private and public sectors. In the private sector all enterprises and consumers can decide autonomously to produce and to consume. In the interwoven public sector it is almost always necessary to work together when a given actor wants to realize a certain policy project. Policy making becomes a process in which the different goals of several organizations have been entangled to become an acceptable compromise.

The pluricentric model and the network perspective

According to Teisman (1991), the network perspective can be seen as an example of the pluricentric view on public policy. The network perspective in policy science was developed in the 1970s as a reaction to the unicentric view of policy making that dominated the field of public policy analysis. The network perspective emphasizes the variety of actors involved in policy making, and also stresses the relatively autonomous actors.

A policy network can be roughly defined as "a social system which is involved with policy problems and policy programs, and which consists of (semi) autonomous actors who find themselves in a dependency relation which is based on the possession of resources that are valued by (one or more) other actors" (Teisman, 1991).

By advocating pluricentric and network perspectives, Teisman plies for a new approach to public policy making in which the main goal of policy making will no longer be the exact implementation of the policy of one actor, but the intertwining of several goals with a satisfactory solution for all of them.

The pluricentric perspective and strategic planning
According to Teisman (2000), strategic policy behavior is very important because without long-term orientation governments tend to become myopic. Nevertheless, strategic policy making is centered on one all-encompassing decision: the adoption of the strategic plan by parliament. In that sense strategic planning builds on the foundations of the unicentric approach to policy making, which is the model Teisman (and other authors) greatly criticizes.
Teisman names three concurrent developments in network society as reasons for the ongoing innovation of strategic planning:

1. dynamics due to global interaction patterns;
2. rising expectations and ambitions leading to complex goals and aims;
3. structural fragmentation leading to network structures in which nobody is in charge.

The complexity of Western society expresses itself in organizational fragmentation, rapid economic change, and increasing and divergent preferences (Teisman, 2000). The expectations and demands of citizens and organizations are rising. The quality of public policy products has to be increased in order to meet the preferences of society. Due to their monopolistic position, public organizations can resist turbulent changes in the market, but if they do not meet societal preferences, they will be confronted with a loss of legitimacy and support. To meet societal demands, the public sector has to continually improve the quality of its products.

In such a society, Teisman claims, plans have a very short life span and new methods must be developed to generate strategic governance capacity. He therefore proposes strategic management as an interactive approach that is able to cope with the high interdependencies of networks. He explains further the specific model of strategic management called concurrent, creative competition (CCC).

Strategic management is like strategic planning as it is based on the complexities of the environment in which an organization has to act. This approach, however, does not use current conditions as points of departure. Instead, it focuses on the development and definition of aims, drawing up and specifying solutions, and on pursuing viable opportunities to link the two. It relies on a continuous supply of information about the environment and avoids the use of planning cycles. It is a continuous process. Strategic management is particularly associated with institutional environments that have the shape of a network.

In the CCC method it is assumed that policy processes which develop in a multi-actor setting, where many actors represent their own interests and add specific information and skills, are superior to processes that are confined to a single organization (Teisman, 2000). In order to make a proper adjustment between strategic plans and actual decision making about investment schemes, it will be necessary to redesign the relationships between government institutions, the public and private sectors, and citizens.

2.2 Van Gunsteren's theory of citizenship

In his book "A Theory of Citizenship" (1998), Herman van Gunsteren describes his view on citizenship in the 'new era', the period after 1989, when radical changes in the global political scene began to take place.

Van Gunsteren starts by specifying reasons why a new theory of citizenship is needed:

- The national society (nation-state) is no longer a self-evident context for political action and order. Externally it is related to competition with political entities such as the European Union, the World Trade Organization, the North Atlantic Treaty

Organization, multinational firms and entities that are unnamed or illegal (e.g. the Mafia). Internally, powerful mass media, big money, and the consumer society have fundamentally altered the traditional landscape of parliamentary democracy, political parties, and the rule of law, within which the position of citizen as voter and addressee of the nation-state was once secure.

- The status of nation-state is changing from the dominant form of political organization to one form among many. The contours of nation states have become blurred in an international system that is multipolar and changing unpredictably.
- The pyramid model in politics based on the logic of rational and central rule is passé (Toulmin, 1992; Van Gunsteren, 1976).
- Sovereignty is divided and fragmented and it has become an outdated concept.
- Politics and rule-making take place in diverse locations that are no longer connected to each other in a stable, hierarchical order.
- Citizens are frustrated with 'unresponsive leadership', people ignore the messages that government send because they seem to be of little relevance to daily life.
- Citizenship has become plural – one person can be a citizen of several different communities (for example, the EU, Turkey and Amsterdam).

The primary notion of citizenship is no longer to make people more equal but to enable them to organize plurality, i.e. to cope peacefully with the differences between themselves and others with whom they cannot avoid dealing.

The orientation that normal politics previously provided is no longer fully reliable or valid and thus people are much more dependent on each other. When (van Gunsteren 1998, p.5) institutional definitions of what counts as political reality are no longer taken as self-evident cultural facts, people are forced to provide meaning, orientation, and dependable relations among themselves. The way to do this, according to van Gunsteren (1998, p.5), is through "citizenship – that is, the individual's acceptance and deliberate molding of a public community of shared fate". And when the constitution of a political regime promotes citizenship as a dynamic principle of its organization – when the regime is "owned" by its citizens – we can call that regime a *republic* (van Gunsteren 1998, p.7). Citizens of a republic are both rulers and ruled: They rule directly, or ultimately, and they obey fellow citizens in their ruling authority as officeholders. Van Gunsteren uses the term republic to prevent identification of this political regime with the nation-state and its parties, parliament, and welfare arrangements.

Citizenship accepts both the reality and the value of individualization and the necessity of cohesion by taking the individual citizen as a paramount principle of public order (van Gunsteren 1998, p.16).

2.2.1 The context: three theories of citizenship

The new political and social realities have made the older theories of citizenship obsolete, because the kind of social order that they presupposed no longer exists. Political and social realities have outgrown the framework within which these three theories of citizenship were embedded (van Gunsteren, 1998, p.17).

In *liberal-individualistic theories*, the citizen is represented as a calculating holder of preferences and rights. The theory has two variants: utilitarian and individual rights. The utilitarian variant is based on the axiom that individuals maximize their own benefit. They calculate what choice of action will render the highest product of the value attributed to the desired situation multiplied by the probability that this situation will occur. In the 'individual rights' variant, choice is defined by citizens' calculations of their own rights within the limits of their respect for the rights of others (ibid. p. 17).

Both variants accept individuals, with their rights, opinions, and choices, as givens, and both variants explain and justify politics in terms of non-political givens. Citizenship and other political institutions are means that are accepted only conditionally – that is, as long as they, in the individual's calculations, promote the maximization of private benefit.

There are two main problems with individualist theory: first, how can individuals be prevented from destroying each other and from destroying the basis of their mutually beneficial interaction? The second problem has to do with the ways in which individuals and their ideas are formed.

Communitarian theories of citizenship strongly emphasize the fact that being a citizen involves belonging to a historically developed community. Whatever individuality the citizen has is derived from and circumscribed by the community. In this vision, the citizen acts responsibly when he stays within the limits of what is acceptable to the community (van Gunsteren 1998, p. 19).

Objections to communitarian theories are that it does not lead to change but rather prevents it, and that communities are notorious for imposing restrictions on freedom.

Republican theories (van Gunsteren 1998, p.21) of citizenship can be seen as a particular variety of communitarian thinking. They place a single community, the public community, at the center of political life. Courage, devotion, military discipline and statesmanship are the republican virtues. Individuality can appear, and individuals can mark their place in history by serving the public community. This is where individuals find fulfillment and public happiness.

The objections against the classical republican conceptions are that in politics military virtue is dangerous stuff. Republican virtues are unilaterally masculine. The republican perspective makes one community absolute and shows too little appreciation for the characteristic values and diversity of other communities.

According van Gunsteren (1998, p.21), the three theories of citizenship are unsatisfactory and offer too little guidance, because the societal conditions no longer exist and cannot be restored simply by insisting on the value of those theories. Contemporary society is no longer a 'civil society' of autonomous individuals. Complex organizations and the accumulation of capital to a large extent determine the course of events. In this society of organizations we find an overwhelming variety of "communities"; government bodies have lost their established places and the national state is no longer the center of authority.

Therefore a new theory of citizenship has to be developed which will fit this 'new society'. That, according to van Gunsteren, is neorepublican citizenship, a concept of citizenship that includes elements of communitarian, republican and liberal-individual thinking, but tries to avoid their negative aspects. And why is his concept possibly the right one? Because, he claims, it does not require that we change social realities before it can begin to work. It accepts the facts of contemporary plurality and of the operative social realities that he labels The Unknown Society.

2.2.2 Neo-republican citizenship

The neorepublican concept of citizenship includes elements of communitarian, republican, and liberal-individualist thinking.

The communitarian elements are that the citizen is a member of a public community, the republic. For the citizen, this community is very important, but in contrast to the communitarian concept, this community is one among many, albeit a community with a special position. The task of the public community is to guard the structure that enables other communities to develop and expand their activities. A core task of the republic is the organization of plurality, not only of individuals but also of communities. The republic creates and protects the freedom of individuals to form communities, to join them and to leave them (ibid. p.24).

The republican elements in the theory of neorepublican citizenship are that neorepublicanism knows virtues but they are not the traditional military ones. They are expressed through debate, reasonableness, tolerance of plurality, and carefully limited use of violence. The term virtue in van Gunsteren's perception is more than simply abiding by the rules. It is a matter of sensibly, competently, and responsibly dealing with authority and situations and positions of dependence. These functions cannot be exhaustively laid down in rules. Individual competence is also essential for the exercise of citizenship.

Neorepublican citizenship demands no overarching or total claims of allegiance to the republic. Neorepublicanism acknowledges that individuals may have deep differences and deep loyalties to other communities. But it does require that in situations when people have to deal with their differences, they do so as citizens – that is, in such a way that access to a position of political equality remains a real option for all persons involved.

Individualist positions of the neorepublican theory are that citizenship is conceived as an office in the public community (p.25). This means that a citizen is to be identified neither with a so-called ordinary person, nor with an entire person. It also means that there are conditions for admission to the practice of citizenship. The republic should not only facilitate access but also formulate and maintain those conditions and promote the development of people into independent and competent citizens. Individuals are not naturally given, they are socially formed.

In the republic, citizenship is the primary office: office holders are primarily citizens who hold an office as part of their exercise of citizenship. These offices are under the supervision of other co-citizens.

Neorepublican citizenship has three very important elements: *the public realm, organizing plurality* and *action*.

The term 'republican' situates citizenship squarely in the *public realm*. It is a matter of public institutions and public ethics. As was already said, citizenship is conceived as an office, an institution in the republic. Citizens are equal in their political standing and say. While political equality is a requirement of citizenship, social equality is not required. However, citizenship in a republic does demand that unequal social relations do not prevent any individual from having a reasonable chance of access to political equality.

To organize plurality is the primary task of neorepublican citizens; being able to do this competently is their primary virtue. Plurality here refers to differences among people who share community of fate.

2.2.3 Remarks

Although the two theories of Teisman and van Gunsteren do not deal with the same questions - Teisman looks at policy forming from the managerial point of view and van Gunsteren from the philosophical - they are very much complementary. We can see the competent citizen of van Gunsteren as a radicalization of the pluricentric perspective: public decision making is not the business of a (more or less accidental) number of involved citizens, rather everybody is in his position of a citizen automatically involved and indeed has to be involved in it.

The ideas of the neo-republican citizen and pluricentism are rather ideal-utopist, as both authors neglect the economy as a part of society. Both theories also presuppose a situation in which individual subjectivity, power play, insincerity, uncertainty, risk, and cultural and social differences are neither present nor have influence on decision-making processes.

Nevertheless, both theories can be seen as an ideal which has the potential to be realized in the future. There are already some attempts to realize these ideas in practice too. One of them is "The Metropolitan Debate" method for decision making in spatial planning, which will be described in Chapter 3.

The aim of this research though, is not to transform society and invent new methods for political decision making, but to create a technology which will enable competent citizens to actively take part in public decision making, thus providing conditions for the realization of the ideas of pluricentricism and neo-republican citizenship.

The implementation of information technology for the democratization of political decision making and the involvement of citizens in public decision making has been a hot issue in the last few years. In the following chapter we will provide a short overview of the current trends in the field of electronic democracy.

2.3 Democracy in the information age: the Internet, Cyberdemocracy and public decision making

For 2500 years, since its inception at the Acropolis, democracy has been evolving into the system we have today. The definition given by Webster's Dictionary explains democracy as "government by the people collectively by elected representatives; political or social equality". The idea behind democracy is thus that the will of the people should guide public policy.

In Athens, all citizens (but note: those who were male, free, Athenian-born landowners) participated in the development of laws in an open forum. Every citizen (who had enough leisure and money) had an equal vote on each issue, and in true participatory democracy style, the topics for discussion were often introduced by the voters themselves. Electronic democracy attempts to achieve this ideal by reproducing the framework for democracy common in 430 BC Greece.

The advantage of electronic democracy over the traditional system is that it allows people to enter into discussion with one another, and with their representatives in government. It also facilitates direct voting or referenda (thus direct democracy), rather than representation by one person who may or may not be in touch with the personal concerns of his constituents. But the former note is rather theoretical, and in democratic practice would only be possible in an ideal situation, when the government is willing or forced to employ electronic networks and therefore change its regular democratic procedures. In addition, opinions strongly differ on whether direct democracy is entirely desirable and whether or not the growth of electronic networks will result in expanded democracy.

In the context of this research the question is whether electronic democracy is able to support the realization of the ideas of van Gunsteren and Teisman.

2.3.1 Authors, definitions and facts relevant to electronic democracy

In the last decade of the twentieth century, the issue of electronic democracy occupied an enormous number of researchers, writers, journalists, cyber-theoreticians, practitioners, governmental agencies and institutions all over the world[1]. In addition to the traditional publishing media and scientific conferences and media events, a lot of work has appeared on the Internet, in the form of electronic books, articles, magazines, discussion lists, virtual chat rooms, community projects, electronic government sites, citizen information desks, direct e-mail services, and so forth. It is not the aim of this chapter to present the overall situation in this field, but to highlight some insights that were the most influential in our own approach to democracy and the design of electronic tools to facilitate electronic democracy.

2.3.2 Terminology: Teledemocracy, Cyberdemocracy and Electronic Democratization

For every layman in the field of electronic democracy it will be a surprise to learn that so many different terms are used to refer to democracy and electronic media, which leads to some confusion about whether all of the authors are talking about the same thing. In principle the differences between the terms concern: to which technology it refers to; which form of democracy is preferred; which dimension of political participation is believed to be the most vital to democracy; and which political agenda is pursued. Here we will present the findings of Martin Hagen (A Typology of Electronic Democracy, 1996), who bases his definitions of electronic democracy terms on the U.S. situation as dominant in the field (but maybe not completely relevant to the European situation).

The term electronic democracy has become one of the most often used by those dealing with the implications of computer technology for political processes. However, according to Hagen (1996), the adjective 'electronic' is not at all precise, because it could also refer to the use of an electronic microphone, television or GSM telephone. There are many other synonyms, to

[1] To mention the most known book authors: Howard Rheingold (Virtual Community), William Mitchel (City of Bits, E-topia), Nicolas Negroponte (Being Digital), Scott London (Electronic Democracy), Neil Postman (Technopoly: The surrender of Culture to Technology), James Fishkin (Democracy and Deliberation), Douglas Schuler (New Community Networks), Manuel Castells (The Rise of the Network Society) etc.
In the Netherlands: J.A.G.M. van Dijk, V.J.J.M. Bekkers, P.H.A. Frissen, D. de Kerchove

some extent more precise, such as 'Digital Democracy' (used by Fineman, 1995) or Cyberdemocracy (Ogden 1994, Poster 1995), 'Virtual Democracy' or 'Information Age Democracy' (Sinder, 1994).
In this text, the term electronic democracy will be used with the idea that 'electronic' implies the application of interactive technology in communication via computer networks.

Electronic democracy as Hagen (1996) defines it, is any democratic political system in which computer networks are used to carry out crucial functions of the democratic process such as information and communication, interest articulation and aggregation, and decision making (both deliberation and voting).

On the basis of four analytical concepts:

- Technological reference objects (communication technologies such as cable TV or computer netwo-rks)
- Forms of democracy preferred (direct of represe-ntative)
- Dimensions of political participation (information, discussion, voting, political action)
- Political agenda(s) pursued (liberal, conservative, communitarian, libertarian etc.),

Hagen distinguishes between three different concepts of electronic democracy: Teledemocracy, Cyberdemocracy and Electronic Democratization. The differences are summarized in Table 2.1 (for a more detailed descri-ption see Hagen, 1996).

Hagen's typology is not exclusive because the concepts of electronic democracy share many propositions and they are often confused in everyday life. Nevertheless, it is important to note that all the concepts of electronic democracy described in Table 2.1 (see at the next page) have arisen as a reaction to a perceived crisis in political participation and decision making.

2.3.3 Accessibility and information availability issues

Before we start discussing theoretical approaches to electronic democracy, let us get a small insight into the technical situation of today's spread of electronic networks. We say a small insight because, although we might expect that statistical data about the use of the Internet would be easily accessible if not traditionally then surely on the Internet, it is actually very difficult to obtain it. For instance the data that is free, such as CBS (Central Bureau for the Statistics) overviews, is not complete. CBS only has data about the number of Internet connections in corporations and government, which for this research is irrelevant because it has been shown that most of the members of cyberdemocracy 'pools' participate from home computers and after working hours. Data about individual users or household connections is maintained by a company called 'Pro Active International'. The company publishes a biannual report which provides global, European and national trend information on (among other things) Internet behavior, other media behavior and e-commerce. But a single copy of the report costs 942 guilders and no library in the Netherlands or Europe has it. On the company's web site we have found Table 2.2, which shows the percentage of inhabitants aged over 15 of 15 European countries who have access to the Internet.

Inhabitants >15 years	Access
1. Sweden	65.2%
2. Norway	59.1%
3. Denmark	54.0%
4. Finland	53.5%
5. Switzerland	49.2%
6. Netherlands	47.8%
7. Gr. Britain	45.6%
8. Austria	39.7%
9. Germany	34.0%
10. France	31.6%
11. Italy	28.7%
12. Belgium	24.9%
13. Ireland	26.4%
14. Spain	12.4%
15. Portugal	11.4%
Europe	34.1%
Europe in millions	107.8

Table 2.2 Internet penetration in Europe
(Source: Pan European Internet Monitor 1st quarter 2000 ©Pro Active International[2])

We can see from the table that in the Netherlands 47.8% of inhabitants aged over 15 have access to Internet, which is far above the European average.

[2] http://www.proactiveinternational.com

Concept	**Teledemocracy**	**Cyberdemocracy**	**Electronic Democratisation**
Origins	Developed in late 1970s, by the use of cable TV	Developed in the late 1980s by the evolution of computer networks	Developed in 1990s by the sprawl of computer networks
Main authors	Ted Becker, Christofer Arterton, Christa Daryl Slaton, Amatai Etzoni, Alvin Toffler, John Naisbitt, Benjamin Barber, Robert Dahl	*Variant 1:* Conservative and libertarian: Progress and Freedom Foundation (PFF) - Alvin Toffler, James Keyworth, Ester Dyson, George Gilder. *Variant 2:* communitarian: Howard Rheingold, Morino Institute, Doheny-Farina.	Abramson/Arterton/Orren, Bonchek
Social group where it most applies	Grassroots activists, political scientists, sociologists, futurologists	Mixture between hippie and yuppie-cultures in the American west, a new 'virtual class'	Members of Congress, White House officials, political scientists and journalists from 'well known' institutions
Main issues	CMC can bridge time and space and make forms of political participation long believed impractable possible; traditional forms of representative democracy cannot deal with complexity of the information age, local forms of democracy and empowerment of the individuals are necessary and via CMC and cable Tv possible; democratic uses of media are necessary as a counter-balance to 'abuses of media due to commercial objectives	creation of both virtual and material communities is central task of 21st century democracy; information is prime economic resource, business and individuals can better maximize their own good via CMC; CMC enables decentralizes, self-government forms of government, thus guarding effectively against state abuses of authority (such as censorship, invasion of privacy etc.)	CMC-based political information systems allow more and freer access to crucial government information; electronic town meetings can create much needed links between public and their elected representatives to deliberate political issues and create a new sense of community among the electorate; because interest groups can lower transaction and organisation costs, civil society is straightened via CMC
Forms of political participation	information; discussion; voting	discussion; political activity	information; discussion
Preferred forms of democracy	less direct, more as a supplement to existing representative structures	direct	improvement of representative democracy
*CMC = computer mediated communication			

Table 2.1 A Typology of Electronic Democracy (based on Hagen, 1996)

Since we cannot see how this amount of 'access' is distributed spatially and demographically, and we do not know the frequency and most represented areas of use, it is very difficult to estimate the number of citizens who are participating (or would in future take part) in 'electronic democracy'.

The Social and Cultural Planbureau (SCP) publishes an annual report on the position of the Netherlands in Europe. Among many other subjects (demography, economy, public management, participation, education, health, etc.) the media are also treated. This year (2000), the report is accessible free of charge via the Internet. Table 2.3 shows the penetration of information and communication technology (ITC) in 16 European countries. The data about Internet connections is from 1996.

	penetratiegraad informatie- en communicatietechnologie					
	aantal televisies per 1.000 inwoners	aantal kabel-aansluitingen per 1.000 huishoudens	aantal mobiele telefoons per 1.000 inwoners	aantal personal computers per 1.000 inwoners	aantal Internet-aansluitingen per 1.000 inwoners	omzet van geluidsdragers (per inwoner, in US-dollars)
Nederland	497	945	33	201	18	43
West-Europa						
België	454	944	23	138	6	44
Duitsland	554	566	43	165	9	39
Frankrijk	589	87	24	134	4	40
Ierland	409	420	44	145	8	24
Oostenrijk	497	386	48	124	11	51
Zwitserland	419	760	64	348	18	57
Verenigd Koninkrijk	448	120	98	186	10	47
Noord-Europa						
Denemarken	574	364	157	271	20	59
Finland	519	352	199	182	56	29
Noorwegen	433	450	224	273	39	61
Zweden	478	420	229	193	26	46
Zuid-Europa						
Griekenland	220	.	26	33	2	12
Italië	446	.	67	84	3	11
Portugal	326	187	34	61	3	16
Spanje	404	.	24	82	3	15
landengemiddelde	454	462	84	164	15	37

a Aantallen per 1.000 inwoners in 1995; Internetaansluitingen in 1996; kabelaansluitingen per 1.000 huishoudens in 1999.

Bron: Unesco (1998), behalve kabelaansluiting: IP (1999)

Table 2.3 Penetration of ITC in Europe (from Social and Cultural Report 2000)

The number of Internet connections in the Netherlands presented here is much lower than in Table 2.2 (1.8% compared to 47.8%). It can be partly explained by the fact that the SCP report takes the total number of inhabitants and not only those aged over 15, and partly because the data is from four years ago. Nevertheless, the difference is so big that it arouses distrust in the accuracy and reliability of both sources.
And it raises the general question of reliability of free data, since in the majority of cases the data that is available (on the Internet) for free is incomplete, out of date, irrelevant or inaccurate.

To conclude, going further into the exploration of theoretical approaches to electronic democracy, we have to be aware that the Net has not yet expanded into the middle income and lower income groups, at least not in anything like large numbers, even in the early adopting countries such as the USA and Australia (in the estimation of Thornton).

In addition to the availability of computer networks and connections to the Internet, other conditions for citizens to be able participate are the ability to use a computer, typing ability, the ability to speak the language of the country where they live, and leisure time at their disposal.

2.3.4 Cyberutopians versus anti-utopians.

The promoters of ITC in democratic movements, 'cyberutopians', believe that new technologies can eliminate the institutional form of democracy with which so many people are dissatisfied. The Internet, in their opinion, will allow a true participatory democracy, in which citizens can govern themselves without the interference of bureaucrats and legislators. In that sense it can be a medium to realize the 'public sphere', a model proposed by Habermas. One of the best-known 'cybe-rutopian' authors is Howard Rheingold with his 1993 book "the Virtual Community".

'Anti-utopians' are, on the other hand, very doubtful whether the growth of electronic networks will result in expanded democracy. In the remainder of the chapter we will explain the arguments of both groups in an attempt to reach a conclusion that will help us position our tool.

Cyberutopian theories

By exploring the possibilities of 'cyberdemocracy', many questions arise, such as: What type of democracy can come out of the Internet? Does the notion of public sphere have any relevance to our current political and social situation? How might the Internet create a new form of democracy that better represents citizens' interests?

Rheingold's ideal of the Internet's part in democracy is based on two main concepts: the Habermasian public sphere, and the part Internet communities play as a focus for democratic activity. As Habermas' philosophy has potential and is much used by 'cyberdemocracy' theoreticians, here we will explain those points from Habermas' works that are relevant to the issues of electronic democracy.

Habermas: The public sphere and civil society

Over the course of thirty-five years, Habermas' writings have been concerned with the capacity of people to create a more just society. In that sense he has developed a special kind of rationality, a rationality that will enable human beings to become more free and equal – the communicative rationality. The project of developing a theory of communication action (and from it discourse ethics) has occupied Habermas for most of his career and is expressed in two of his books, one being among his earliest works and the other among his most recent. The first is *The structural Transformation of the Public Sphere* (1962), and the second is *Between the Facts and Norms* (1992). Both these books (as well as a portion of Volume 2 of *The Theory of Communicative Action,* 1987) focus on the social world, politics, and the formation of public opinion. Thus, his works center on two interrelated and strongly connected themes: (1) the capacities of social agents in their communicative actions and (2) the political realm in which they interact.

Communicative Reason

In contrast to Max Weber, who saw reason as a tool of bureaucracies and other oppressive institutions as an instrument for gaining domination and control, Habermas sought to find rationale to believe in reason. He noted that, in addition to instrumental and functional reasons, there was another kind of reason – communicative reason, one that can provide a critical 'ground' for freedom.

According to Habermas (1982), instrumental reason is geared towards reaching success (i.e. attaining some given end) by whatever means necessary. In that sense it is similar to functional reason, as both are in the service of meeting predetermined ends. Functional reason, though, guides systems, such as the bureaucratic, economic, and administrative systems that control various spheres of society today. Instead of being guided or 'steered' by expectations of rightness and sincerity, these systems are steered by, for example, money and power. So, Habermas' goal is to halt the intrusion of the system into the lifeworld[3], in

[3] In Habermas's sociological analyses of society, the lifeworld is identified as the 'context-forming horizon' of social action (Habermas, 1984, XXV); it consists of the background assumptions, cultural norms, expectations, and meanings that

part by explicating the characteristics of communicative action.

Communicative reason is immanent to our communicative action; it is the quasi-transcendental possibility of engaging in conversation, historically arising from human interests. It is typified by an *expectation* that one's interlocutor will speak sincerely, truthfully, openly, and uncoercively. These expectations are how we reason when we talk in order to reach understanding with others. In our everyday conversations we expect something that Habermas calls the 'ideal speech situation': that communication for reaching understanding should be uncoerced, egalitarian, sincere, and truthful[4].

The public sphere

Like the postmodernists, Habermas hopes to create a dialog which occurs outside of the realm of government and the economy. The pubic sphere is

> "A domain of our social life in which such a thing as public opinion can be formed. Access to the public sphere is open in principle to all citizens. A portion of the public sphere is constituted in every conversation in which private persons come together to form a public… Citizens act as a public when they deal with matters of general interest without being subject to coercion; thus with guarantee that they may assemble and unite freely, and express and publicize their opinions freely…. We speak of a political public sphere (as distinguished from a literary one, for instance) when the public discussions concern objects connected with the practice of the state." (Habermas, 1989, in McAfee, 2000)

The political public sphere is thus not so much a physical place as it is an occurrence: any time two or more individuals come together to discuss matters of politics the public sphere takes place. Otherwise, 'private' individuals create a public sphere when they talk together about public concerns. In this respect, the public sphere is neither part of the private realm of the household and of individuals, nor is it a part of the official structures of governance. It occurs in a third, intermediate space.

This intermediate space, according Walzer (1991), is civil society, the third 'realm' between private individuals and the state (or government). "The words 'civil society' name the space of uncoerced human association and also the set of relational networks formed for the sake of family, faith, interest, and ideology – that fill the space. (Walzer, 1991, in McAfee, 2000).

Civil society is the network of all those non-governmental associations, both formal and informal, that brings people together: from garden clubs to neighborhood associations, churches, labor unions, bowling clubs and so forth. Their objects do not matter, what they share is a way of bringing people out of their homes and workplaces. People do not necessarily act politically in these associational groups but they can develop the capacity to create and articulate public will and direction, to address immediate concerns and to decide the legitimacy of their governments. At best, civil societies foster an open, democratic culture that helps set their political communities' direction and holds their governments accountable. Civil society can provide a bulwark against the illegitimate use of state power. If the people are prevented from coming together and voicing their displeasure with the state, the state can masquerade as legitimate.

Civil society can be considered as the space or realm in which the political public sphere arises (McAfee, 2000). One could conceive of the public sphere as a segment or aspect of civil society; whenever or wherever two or more people discuss matters of the state, then the public sphere occurs: it is the occurrence of public dialog on matters of public policy. In this sense the public sphere is always a discursive space.

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we use to interpret and make sense of our experience and to coordinate our actions with others. The system, on the other hand, is society conceptualised in terms of the division of labour and functions into separate spheres of actions and goals (e.g., banking system, educational system, political system), each with its own predetermined ends and selected means for achieving them.

[4] Habermas does not argue that the ideal speech situation actually occurs but rather that we have it as a regulative ideal by which we judge actual speech situations.

Habermas and cyberdemocracy: A reconception of the public sphere

For Habermas, the public sphere is 'a discursive arena that is home to citizen debate, deliberation, agreement and action' (Villa, 1992 in Gaynor, 1996).

As we have already mentioned, the political public sphere is not so much a physical place as an occurrence. The public sphere is neither part of the private realm, nor part of the official structures of governance; it occurs in a third, intermediate space.

Here Habermas closely resembles the true participatory democracy advocated by electronic networks, and even more, electronic networks that are breaking the physical boundaries that limit discourse and information access, are more than appropriate to capture the 'occurrences' of intermediate space.

By allowing every person the same opportunity to participate in discourse, Habermas hopes to eradicate the prejudices which limit marginalized groups (women, black people) from fully attaining their rights in democracy. Since the Internet de-emphasizes the body as a characteristic for social evaluation[5], users are able to interact on an equal level. The public sphere, therefore, manages to generate a political space that respects the rights of the individual and strengthens community. Because the communication that takes place in the 'ideal speech situation' is free of institutional coercion, dialog in the public sphere can "institute democratic discourses on the grassroots level (Ingram .., in Ess, 1994). "If the rules of Habermas' 'ideal speech situation' can be transferred to current electronic networks, the possibility arises for a democracy which can truly represent both citizens and community interests" (Gaynor, www.georgetown.edu/ bassr/gaynor /idealsp.htm.

According to Gaynor (1996), the participatory form of democracy which electronic networks assist and create can help steer political activism on an unrestricted level (grassroots level). Ideally, this activity occurs in a realm similar to Habermas' public sphere, which exists outside the dominant institutions of government and business. Through bulletin boards, e-mail and the WWW, individuals who otherwise might never have contact, can interact and coordinate on any number of issues.

[5] "On the Internet, nobody knows that you are a dog" W. Mitchell, City of Bits

Hagen (1996) names three reasons why the introduction of computer networks can work as a remedy for political participation. First, computer networks create new information and communication channels between the public and decision-makers. Second, they are believed to empower and strengthen the political polity by fostering or creating new (virtual) political communities. Third, the use of computer networks in the political process has the potential to increase political participation and thus strengthen the democratic political system.

Thornton (1996) names two supporting factors for the Internet as having the potential to revitalize the public sphere (factors that do not overlap with traditional mass media):

1. The anarchic structure of the Internet, i.e. the Internet is not a physical structure comparable with traditional mass media such as broadcasting companies or newspaper publishers, which are concentrated and finite in number. It is spread across an enormous number of computers all over the world.
2. Interactivity, i.e. the possibility to directly 'talk back'.

While mass media like television, radio and print have shown their abilities to support or subvert traditional institutions of power, electronic networks offer the most comprehensive means for upsetting societal hierarchies. Moreover, the participation in self-governance can lessen the public's reliance on legislators and bureaucrats. As people become better informed and have the opportunity to organize at the grassroots level, the need for strong central control by the state dwindles (Gaynor, 1996). But here the question arises: in a decentered world, what type of restrictions might be placed on cyberdiscourse to maintain the stability of the state apparatus?

Anti-utopian arguments

The utopian belief that electronic democracy fosters direct participatory democracy via electronic networks is greatly criticized by anti-utopians. They argue that the number of issues that even local government must deal with is daunting for even the most committed citizen (Thornton, 1996). With today's population it is impossible for all citizens to have a voice in every issue.

Generally most people have pressing day-to-day concerns that take their attention away from the in-depth ramifications of spatial plans, infrastructure investments, changes in taxation and so forth. Therefore elected political officials have traditionally performed the role of the concerned and knowledgeable citizen for us. Even if all citizens were to take over that duty, anti-utopians fear that this inundation of texts and voices would lead to anarchic rather than democratic forms of communication, in which multiple centers would compete with one another in a debate which would only lead to complete divergence and fragmentation (Gaynor, 1996).

Sclove (1996) notes five reasons why electronic technologies fail to make our society more democratic:

1. In new types of media part of what is lost is that the original whole was partially constituted by a context that was essentially tacit, open-textured, and non-specifiable;
2. Screen-based technologies encourage passivity and a withdrawal from social interaction;
3. Participants can exit quickly, which raises the potential for replacement of long-term relationships with shallow, short-term ones;
4. While we may interact with others across long distances, our bodies always remain locally situated. This phenomenon may cause us to grow indifferent towards our physical neighbors; and
5. Specially dispersed social networks can subvert a collective capacity to govern the locales people physically inhabit.

Another argument of anti-utopians is that with the intrusion of the Internet into many facets of life, personal freedom will be impeded and the existing rift between the 'haves' and 'have-nots' in society will grow.

The claim that the Internet can lead to greater democratization is, among other things, founded on the tenets of unlimited access to information. However, here the question arises of which information is freely available on the Internet (as much of it is only available at a cost – at least in the Netherlands – which further underlines the difference between 'haves' and 'have-nots'), and there are also questions over the authenticity and accuracy of this information.

With all media there is a fine line between the communication of views and propaganda. In cyberspace it is especially difficult to prove the origin of information. It is also true that those who are generally dominant in the information world would stay dominant on the Internet too, because governments and corporations have abilities to utilize the Internet for their own purposes, like any other user, but on a much larger scale. The issues of governmental censorship, control and encryption cause anti-utopians to doubt the real value of electronic democracy.

2.3.5 Spatial planning and electronic democracy in the Netherlands

Similar to the general aims of electronic democracy, the hope of planners is that the new technologies will enable them to have better communication with civil society (Kunzmann, 2000). In the Netherlands in the last few years this question has been among the most discussed among scholars, politicians, professionals and citizens. Many practical experiments have been conducted and almost every day new ones are set up, all of them trying to find the answer to the question: In what way can electronic democracy play a positive role in the future spatial development of the country?

'Interactive policy forming' (*interactieve beleidsvorming*) or 'participative policy development' (*participatieve beleidsontwikkeling*) are the terms most used in Dutch scientific and professional literature. Interactive policy forming is defined as 'a process of common policy forming, directed to a shared policy practice in the network of mutually dependent actors' (Door and Enthoven, 1997). Many authors see the solution for the improvement of spatial policy forming, the design of spatial plans and spatial decision making in open planning processes and co-production (de Lange, 1999). 'Interactivity' here is not associated with direct feedback, as it is assumed in the computer world, but with the obtaining of the basis (for policy forming) through involvement of the interested parties (citizens and social organizations) in an *early* stadium of the policy forming. The moment when citizens can react to policy proposals is in Dutch law called '*inspraak*'. The practice of '*inspraak*' usually takes place when all the crucial decisions have already been made[6]. In 'interactive policy forming' it is moved forward, to an earlier stage of policy development.

The traditional definition of 'inspraak' says that it is 'an opportunity organized by authorities for citizens to express their opinion about policy' (Propper and ter Braak, 1996 in Zundert 1997). This definition, according to Zundert, no longer works and new forms of 'inspraak' are appearing such as 'city-talks' (statsgesprekken) and 'digital debates'. Both forms occur when the municipal government has some ideas about a problem but has not yet taken crucial decisions. In that situation the government invites citizens to a discussion in order to find a solution jointly.

As the definition says, inspraak is an event *organized by the authorities*, so it is in the Dutch practice of electronic democracy. In the great majority (if not all) of cases, the government (either central or local) is the initiator or supporter (completely or partly) of experiments with the involvement of electronic networks in democratization processes. Some examples of interactive policy forming projects that deal with spatial planning and (large) infrastructure projects are as follows:

- Foundation Land Water Information Technology (LWI)[7]
- Instituut voor publiek en politiek en stichting Agora Europa: Geef mij de ruimte[8]
- Ministry of spatial planning and environment: VROM-discussieplatforms[9]
- RPD (Nederland 2030)
- Ministry of Traffic and Watermanagement: Infralab
- Ministry of Inner Affairs: Handleiding voor electronische burgersconsultatie
- Province North Brabant: Teledemocracy in the province/Beslisswijzer[10]
- Municipalities of:
  - Amsterdam – Transparent Amsterdam[11]: projects Zuidas, Marcanti-eiland, Central zone Amsterdam North, Het Digitaal Verkeersplein
  - Zwolle – Zwolle city Development[12]

This shows that in Dutch spatial planning practice most of the 'electronic democracy' initiatives are directed more to the improvement of contact between the representatives and their 'basis' rather than to the involvement of individual citizens in direct democracy. Representative democracy has its established position in the Dutch society, which will be very difficult (if at all desirable) to transform into the direct form of democracy[13]. It is much more realistic to expect that 'interactive policy forming' will lead to a kind of representative democracy with direct aspects.

Although initiatives for the employment of electronic networks in spatial policy forming are growing, the proportion of 'traditional' strategic planning in relation to the new forms of participatory planning is still much higher. Much needs to be done before the traditional ways of planning and decision making are replaced with the new forms which rely on citizens' participation and direct democracy.
The conditions for change are shown in Figure 2.1.

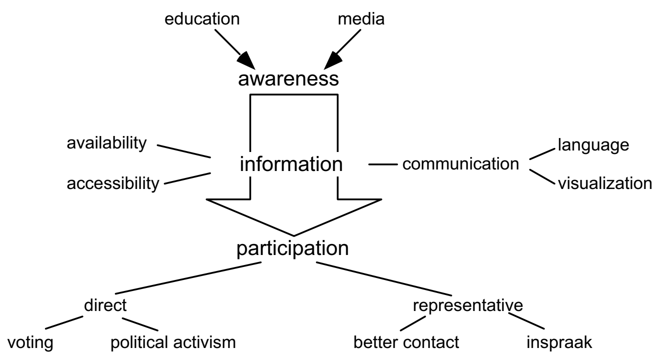

Figure 2.1 Conditions for and forms of citizen participation in spatial decision making

The first condition to enlarge the circle of participating citizens is to raise their awareness of the importance of spatial planning. This can be done through education

[6] This is the cause of great frustration of citizens as they are put in the position of neglected party, only being able to give comments when the major decisions are already taken. The communication in the classical *'inspraak'* is seen as one-way process, where the receiver is seen as dependent from sender, in this case the planning agency.
[7] www.lwi.nl
[8] http://www.geefmijderuimte.nl
[9] http://vrom.design.nl/open?MIval=nsIndex
[10] http://www.euronet.nl/users/in001821/brabant/000/TD_Mod.htm
[11] http://www.transparant.net/amsterdam/ta.html
[12] http://www.zwolle-city-development.nl/htmlversion/default.htm
[13] The similar situation is in the other fields too. The website www.overheid.nl gives the links to all Dutch governmental sites on the Internet.

(involving spatial planning issues in secondary school curricula) or through media such as television, radio and the Internet.

The next and most crucial step is the provision of proper, accurate and up-to-date information through the Internet. This means that official web sites have to be permanently updated and maintained. The presentation of information should be adjusted to the ordinary citizen, which means that technocratic language should be replaced with language understandable to everyone, and visualisation should replace long, boring documents. Only when these conditions are fulfilled can participation take place in different forms: direct, by voting or political action (such as referenda), or representative, through improved interaction between citizens and their representatives.

2.4 Position of the research in the theoretical framework

Figure 2.2 shows the position of this research in the theoretical framework. Each round-cornered rectangle presents the main subject of the theories with two antipodes and in the middle is the core of the idea of

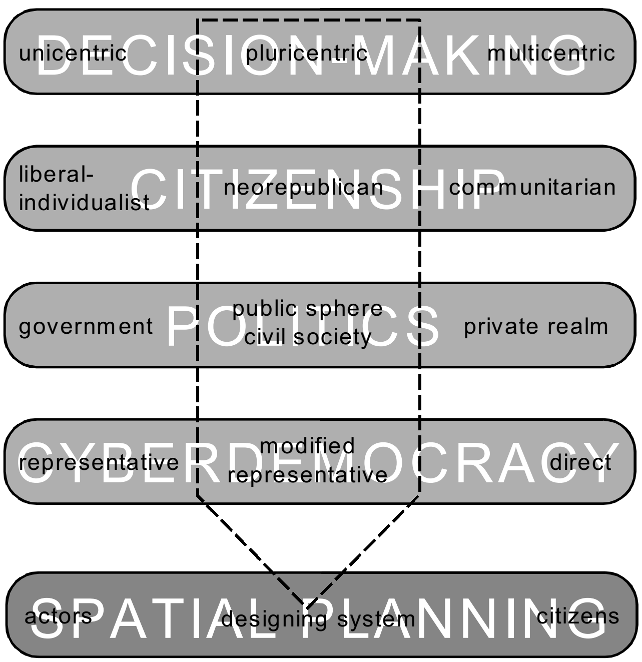

Figure 2.2 Theoretical framework of this research

the theory concerned. The arrow joining the middle parts of the round-cornered rectangles presents the choices which we made in this research.

The position of the research in the theoretical framework is:

1. in spatial decision making, between a unicentric and multicentric model of decision making, we choose a pluricentric one;
2. looking at the theories of citizenship, the system is designed for the neo-republican citizen;
3. in considering the relationship between citizenship and politics, we have chosen the 'public sphere' and civil society as a realm which occupies the space between private and governmental spheres;
4. looking at the ways in which 'cyberdemocracy' could be realized, we have chosen a modified representative;
5. spatial planning is not the task of either actors or citizens, but for the 'designing system' which joins both of them.

This research would result in our own approach to spatial planning: a combination of designing and deciding through the involvement of neo-republican citizens in a pluricentric network of independent actors who are – supported by information technology – able to jointly shape their environment.

Figure 2.3 (see the following page) is a visual illustration of policy forming and decision making as the interaction of neo-republican citizens and their organizations through electronic networks.

This figure represents our own approach to spatial decision making. There, designing is no longer seen as the exclusive competence of a planning agency or urban design office which develops plans on the assignment of authorities or investors, and decision making is not seen as a strict procedure which is exercised only by the government. Designing of spatial plans and decision making about them, in the scope of this research, is seen as an integrated action of all interested societal actors, including citizens. Hence in this research the term designing system is used for a coalition of governmental, institutional and individual actors.

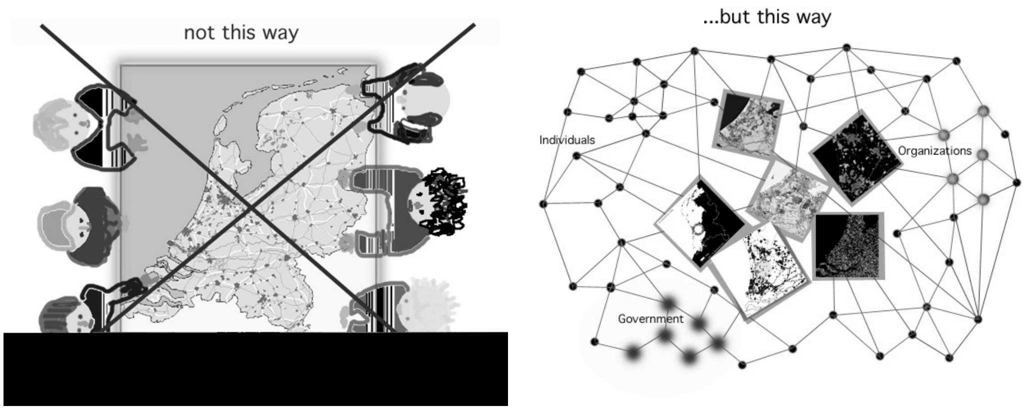

Figure 2.3 Policy forming resulting from the unicentric approach can be replaced by the new forms of planning through the interaction of a designing system via an electronic network

2.5 Requirements for the Delta•M DSS based on the theoretical framework

The requirements for the Delta•M DSS presented in the lists below are derived from the position of the research in the theoretical framework presented in the previous section. These are:

1. The requirements for the Delta•M DSS related to pluricentric decision making are that the Delta•M DSS should:
   - be available to all the actors in the decision-making process.
   - provide interaction between central and decentral actors.
   - provide a platform where actors would negotiate their common interest.
   - provide the tools for actors to be able to exchange knowledge, negotiate over investments, and to determine responsibilities.
   - provide a platform for decision making about specific issues in series.
   - be designed to give actors policy freedom and autonomy.

2. The requirements for the Delta•M DSS related to neo-republican citizenship are that the Delta•M DSS should:
   - be open to every citizen.
   - be free for individuals to form communities and organize plurality.
   - provide a platform for the debate of neorepublican citizens.
   - provide a platform for the exercise of individual competence.
   - provide access to a position of political equality to all citizens involved.
   - enable exercise of the office of citizenship.
   - enable supervision of the office by other co-citizens.

3. The requirements for the Delta•M DSS related to the public sphere are that the Delta•M DSS should:
   - provide a dialog which occurs outside the realm of government.
   - provide an environment for the forming of public opinion.
   - provide access to the public sphere to all citizens.
   - provide an environment where citizens would be able to express their opinion freely.
   - provide a discursive arena that is home to citizens' debate, deliberation, agreement, and action.

4. The requirements for the Delta•M DSS related to electronic democracy are that the Delta•M DSS should:
   - be available via the World Wide Web.

- give the same opportunity for participation to all social groups.
- provide users' interaction on an equal level.
- respect the rights of individuals and strengthen the community.
- create new information and communication channels between citizens and decision-makers.
- increase political participation.
- help break down established societal hierarchies and bureaucracy.
- stimulate interaction between citizens and their democratic representatives and thus maintain the stability of the state apparatus.
- support modified representative democracy.

2.6 Conclusions

In this chapter we have explained the theoretical framework of this research, which is based on the theories of pluricentrism, neo-republican citizenship, and electronic democracy. We looked at how these theories can contribute to the democratisation of spatial decision making. We have found that the theories of pluricentrism and citizenship are complementary in the sense that they both advocate an open planning process where the participation of citizens is considered as a part of the process. A 'cyberdemocracy' that gives the floor to all parties needs a guiding model that stresses freedom and equality, because institutional forces threaten to use electronic networks for their own gain. A framework, then, like the one outlined in Habermas' public sphere, Teisman's pluricentrism and van Gunsteren's neo-republican citizenship, can serve as an alternative to institutional coercion.

Further in this chapter we related the latest literature on electronic democracy to the situation in Dutch society, such as the accessibility of information and the implementation of electronic democracy in spatial planning. We concluded that in Dutch spatial planning practice most cases of electronic democracy are directed to the improvement of citizens' information by means of the Internet, and inviting citizens to express their opinions vie e-mail so as to improve the contact between citizens and public authorities. This confirms the findings of Gaynor (1996), who argues that at this moment in its development, electronic democracy is still far from the ideals of the public sphere, pluricentrism and neo-republican citizenship. The primary use of the Internet for democratic purposes is in the representative, rather than direct democracy, approach so greatly advocated by the cyber-utopians like Howard Rheingold.

We have positioned our research within a theoretical framework, and defined the term *designing system* as a coalition of governmental, institutional and individual actors who design and decide together. Finally we translated the theoretical framework into a set of operational requirements which will be used in the development of the Delta•M DSS.

In the next chapter we will explore the technologies that can help us to realise this theoretical framework. They are Decision Support Systems and Information communication technology represented through the World Wide Web.

3. Decision Support Systems in Spatial Planning

With the rapid development of computer technology, the sprawl of personal computers, the decrease in the price of hardware, and the development of user-friendly software in the last two decades of the twentieth century, numerous practical applications of decision support systems (DSSs) have appeared in almost all fields of human activities. This chapter will provide an introduction to the basics of decision support systems by examining various definitions, origins, and the theoretical background of DSSs. Special attention will be given to spatial DSSs (SDSSs) and planning support systems (PSSs), which are a specific kind of DSS used in urban design and spatial planning.

The chapter will explore the broad literature on DSSs and provide some practical examples of existing systems. We will examine the overall applicability of those systems and their advantages and disadvantages. The possibilities of decision support systems for the accommodation of the theories of citizenship, pluricentrism and electronic democracy will be explored. The review of advantages and disadvantages of the DSSs will form the framework for the definition of the second set of requirements for the system which is the product of this research.

3.1 Definitions

There are numerous definitions of DSSs, some of them very broad and others very specific. Many authors would say that any collection of data that is relevant to some problem could be called a decision support system. These very vague definitions come from a managerial approach in which 'good decision making' means that we are informed and that we have relevant and appropriate information on which to base choices (Sauter, 1997). In the opinion of Power (1998), a DSS should not be too complicated and ambitious because decision-makers can sometimes benefit greatly from just rapidly retrieving a single fact; or benefit from being able to perform a simple ad hoc data analysis; or by viewing data in pre-specified reports or screens in a rudimentary expert information system (EIS). When the amount of information exceeds the person's cognitive capacity, a psychological phenomenon called 'cognitive overload' occurs. DSSs can reduce or increase cognitive overload (Power, 1995-1998).

On the other hand, this simple definition would not be satisfactory if we would expect DSSs to project and predict the consequences of our decisions. A step forward in narrowing the definition of DSSs would be that 'a collection of data' has to be transformed into 'information'[1] in order to support a decision-maker in getting a faster and better insight into the problem. According to Sauter (1997), the information comes in the form of facts, numbers, impressions, graphics, pictures, and sounds. It needs to be collected from various sources, joined together, and organized. The process of organizing and examining the information about the various options is the process of modeling[2]. Models are created to help decision-makers understand the ramifications of selecting an option. The models can range from quite informal representations to complex mathematical relationships. Starting from these propositions Sauter gives the following definition of DSS:

Decision support systems are computer-based systems that bring together information from a variety of sources, assist in the organization and analysis of information, and facilitate the evaluation of assumptions underlying the use of specific models.

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[1] There is a kind of interdependence between the terms 'data' and 'information' that we will try to explain here. By definition, data are facts which can be used as a basis for reasoning (Johnson et al., 1967), but data are only potentially information and they must first be processed in order to become information (Bonaczek et al., 1981). A collection of data is called a database. A database can convey information and then information processing goes hand in hand with data holding. In that sense the usage of a database is a kind of information processing.

[2] According to Bonczek et al. (1981), a model is a plan for information processing that involves some transformation of information. The models are tools for extending a decision-maker's capacity for coping with complex large-scale problems. However, the decision-maker also performs internal information processing, in which the pattern of thought may be considered a mental model. In attempting to observe this pattern, we find that it is frequently quite elusive. It is difficult to describe or externalize and is usually referred to as being 'subjective'. It is nonetheless a type of information transformation that is an important, valuable aspect of decision making.

Bonczek et al. (1981) define decision support systems as interactive computer-based systems that help decision makers utilize data and models to identify and solve problems and make decisions. The "system must aid a decision-maker in solving unprogrammed, unstructured (or "semistructured")[3] problems ... the system must possess an interactive query facility, with a query language that ... is ... easy to learn and use. DSS help managers/decision-makers use and manipulate data; apply checklists and heuristics; and build and use mathematical models. "

Mitra (1988) argues that a DSS is a computer-based application system that helps the problem owners to make decisions. Although simple, this definition assumes complex actions that decision-makers have to perform to come to a decision.

Nowadays more requirements are put upon DSSs and therefore more complex definitions of DSSs are appearing, such as those of Turban (1995) or Keenan (1997). These definitions summarize all characteristics of DSSs in four major features:

- DSSs incorporate data, models and interface
- they are designed to support decision-makers in semistructured or unstructured decision tasks;
- they support, rather than replace, the user's judgment; and
- their objective is to improve the effectiveness of the decisions, not the efficiency with which decisions are made.

One of the most recent definitions is that DSSs are "computer systems able to assist the decision-makers by analyzing issues and proposing solutions" (Laurini, 2001, p. 10).

However they are defined, the main aim of the work on enhancement of decision support systems is to make them capable of projecting and predicting the results of decisions before they are made. These projections should allow decision makers to evaluate the possible consequences of decisions and to try or test several alternatives 'on paper' before committing valuable resources to actual programs. In addition to this, the objective of a DSS could also be to improve the efficiency of decision-making process by accelerating it.

3.1.1 Spatial Decision Support Systems and Planning Support Systems

Specific applications of DSSs used in physical planning are spatial decision support systems. These are developed for use with a domain database that has a spatial dimension or for situations where the solution space of a problem has a spatial dimension. (Wright and Buehler, 1993). SDSSs are thus a subset of the wider family of DSSs that focus on spatial (geographical) processes relevant to a particular decision problem (Carver, 1996).

The essential characteristics of an SDSS is that it integrates a geographical information system (GIS) with a computer-based spatial analysis module, map analyses and display modules. In that sense an SDSS operates with maps and images more than other DSSs used in managerial science and practice. In most cases SDSSs are built around a GIS framework, but alongside GIS they incorporate modeling capabilities, expert knowledge and graphical user interfaces.

The term 'planning support systems' was originally proposed by Britton Harris in 1989. There is a great similarity in the definitions of SDSSs and PSSs. According to Batty (1995) and Klosterman (1997), planning support systems are integrated systems of information and software which bring the three components of traditional DSSs - information, models and visualization - into the public realm. Klosterman (1999) explains that PSS information includes not only spatially referenced information stored in GISs but also small area statistical

[3] Structured Decisions - standard or repetitive decision situations for which solution techniques are already available (also sometimes called routine or programmed decisions). The structural elements in the situation, e.g. alternatives, criteria, environmental conditions, are known, defined and understood.
Semistructured Decisions - decisions in which some aspect of the problem are structured and others are unstructured.
Unstructured Decisions - this type of decision situation is complex and no standard solutions exist for resolving the situation. Some or all of the structural elements of the decision situation are undefined, ill-defined or unknown. For example, goals may be poorly defined, alternatives may be incomplete or non-comparable, choice criteria may be hard to measure or difficult to link to goals. (Power, 1998)

data and information stored in other media such as text and graphic images. PSS models include planners' familiar tools for conducting analyses, projecting future conditions, and modeling spatial interaction and new tools such as expert systems and artificial neural networks. PSS visualization includes both planners' traditional charts, graphs, and maps, and also three-dimensional simulations and multimedia text, video, and sound. Supporting all three of these components can, according to Klosterman (1999), give PSSs a new role in public policy making and collaborative decision making.

PSS is now a widely accepted term which encompasses a range of concepts broader than the term SDSS (Kammeier, 1999), so it may also be equated with the less common *spatial informatics* which is claimed to be the most comprehensive conceptual term reaching clearly beyond the present limits of GIS (van der Meulen, 1995).

3.1.2 Origins of DSS

The nature of human decision making has been the subject of research in philosophy, mathematics, psychology and behavioral science, but the concept of modern DSSs emerges from management science and database technology.

According to Keen and Stabell (1978), the concept of Decision Support evolved from two main areas of research: the theoretical studies of organizational decision making carried out at the Carnegie Institute of Technology during the late 1950s and early 1960s and the technical work on interactive computer systems, mainly carried out at the Massachusetts Institute of Technology in the 1960s.

In the 1950s, when the primary applications of computers appeared in management science, the foundations for the development of decision support systems (DSSs) were established. In the 1960s computers were applied to the routine decision making problems of managers, and this is the period when management information systems (MISs) emerged. These systems used the raw data from data-processing systems to prepare management summaries, to chart information on trends and cycles, and to monitor actual performance against plans or budgets. Common to all advanced definitions of DSSs is that these systems must support a particular type of decision. This characteristic distinguishes DSSs from general purpose MISs.

A number of disciplines provided the substantive foundations for DSS development and research. Data processsing has contributed tools and research on managing data. Management Science has developed mathematical models for use in DSSs and provided evidence on the advantages of modeling in problem solving. Cognitive science, especially behavioral decision making research, has provided descriptive information that has assisted in DSS design and has generated hypotheses for DSS research. The roots of DSS are partly in Systems Science, the core of which includes that the problem is defined and the objective of the system must be viewed in relation to the other components and to larger systems/the whole system (Churchman, 1979). In terms of theory Systems Science has considerable impact on user interfaces (Eom, 1996).

The term 'decision support' first began appearing in the titles of conferences and research papers in the early 1970s. It appears to be an offshoot of the management information systems (MIS) area, which in turn stems from database management, which has its roots in file management. Decision support systems differ from management information systems in their emphasis on (Bonczek et al., 1981): (1) incorporating models into the information system software, (2) providing useful information to higher-level management so as to support comparatively unstructured decision activities, and (3) furnishing the system's users with powerful yet simple-to-use languages[4] for problem solving.

As stated previously by Sauter (1997), a DSS is a computer-based system that supports choice by assisting the decision maker in organizing information and modeling outcomes.

Figure 3.1 (see at the next page) illustrates a continuum of information systems products available. In this diagram, the conventional management information

[4] What Bonczek refers to as a 'language' or 'query language' is nowadays called user interface.

system (MIS) or transaction processing system (TPS) is shown at the far left. The MIS is intended for routine, structural, and anticipated decisions. In those cases, the system might retrieve or extract data, integrate it, and produce a report. These systems are not analysis oriented, and they tend to be simple, batch-processing systems. Therefore, they are not good for supporting decisions.

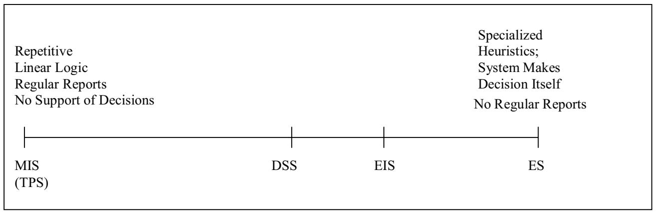

Figure 3.1 Continuum of information systems products (Sauter, 1997)

The far right of Figure 3.1 illustrates the expert system (ES). ESs are intended to reproduce the logic of a human who is considered an expert for the purposes of a particular decision. The systems generally process a series of heuristics that are believed to mimic that logic. They are good at supporting decisions, but only those decisions that they have been programmed to process.

In between those two is the area of the decision support system and the executive information system (EIS). These two types of systems are intended to help decision-makers identify and access information they believe will be useful in processing poorly structured, unspecified problems. They provide flexible mechanisms for retrieving data, flexible mechanisms for analyzing data, and tools that help understand the problems, opportunities, and possible solutions. They enable the decision makers to select what they want in both substance and format.

3.1.3 Origins and the state of the art of Planning Support Systems

It was not long after the first generation of computers had been brought to use for military, banking, and statistical operations, where large volumes of numbers had to be processed, that computing for urban and regional forecasting and management tasks began to be applied. The search for a scientific paradigm of planning, separate from its earlier domination by design professions, logically suggested the formulation of mathematical models for urban and regional development (Kammeier, 1999). Rapidly increasing motorization and the need for effective transport-planning methods urged the development of computer-aided models for analyzing and projecting the interaction of urban land use and changes in transpo-rtation patterns. The need to cope with transport and traffic management created the first successful compu-ter applications specific to urban planning. The Chicago area transportation study used computers to run its models and displayed some of its results as travel desire lines on a primitive cathode-ray tube in 1950s (CATS, 1960; from Hopkins 1999). Harris (1960) has long argued for an approach to planning that combines sketch planning - rapid and practical descriptions of alterna-tives - with state of the art modeling of the implications of these alternatives. Branch (1971) described an elabo-rate system for 'continuous planning', including the design of a room for collaboration with citizen boards. Most of the tasks we now imagine for a PSS were included in his proposal, but at that time computing was mostly used for calculation and not for display of images of direct interaction. More recently, Harris and Batty (1993) argued for coherent sets of tools for complex planning tasks. They identify two principal requirements for planning, which devolve onto any planning support system:

- First, since optimization (which equates with automatic plan generation) is impossible, the search for good plans must be by way of an informed process of trial and error, which generates alterna-tives and prepares them for testing. This is often called sketch planning.
- Second, planning and policy making need extensive tools for tracing out the consequences of alterna-tives, since otherwise there is no way to compare alternatives on the basis of their costs and benefits, and no way to look for means of improving or replacing alternatives (pp. 193-194).

The diffusion of microcomputers in the last two decades of the twentieth century has made the whole range of computer-based tools and techniques readily available to planners around the world. The excitement surro-unding computer-based planning gained further impetus as computer equipment increased in power and speed and decreased in costs, the quantity and the quality of spatial information which became available with the sprawl of GIS technology in governmental organizations improved, and the Internet showed incredible growth.

Although the idea of a planning support system has already been around for 25 years and many attempts have been made to build an overall useful PSS, there is still no underlying structure that integrates the loose components of existing systems (Hopkins, 1999; Kammier, 1999).

With the improvement of computational power, image processing has become a routine action and graphical displays have become high quality, and many tools useful for particular planning tasks have been developed. Nevertheless, there is as yet no coherent system that links a wide range of tasks from sketch planning to modeling (Hopkins, 1999).

The reason for such a situation certainly lies in the complexity of the spatial planning profession, but many authors would relate this problem to the lack of GIS techniques to fully support planners' needs. Hopkins (1999) argues that the tremendous success of GIS on the market distracted us from the development of PSS. "The underlying structure of a PSS should be different from that of GIS because in a PSS we want to manipulate elements of the situation for which we are planning, and these elements are not inherently features of maps." (Hopkins and Johnston, 1990, from Hopkins, 1999, p. 334). According to Kammeier (1999), although the amount of GIS applications and the possibilities they offer is confusingly large and still growing, GISs still have difficulty in dealing with core areas of planning. "These are the typical 'what will happen, if…?' questions to be explored and answered before any decisions can be made with a good faith" (p. 367).

Other kinds of PSS applications, such as "UrbanSim" (www.urbansim.com) or "What If?" (Klosterman, 1999), which are not GIS based, but can be connected to GIS databases, have received a lot of attention in the last few years. But although they seem to be promising tools for building and accessing detailed urban development scenarios, they are not widely used in planning practice, especially not in Europe. So the real PSS is still only in the conceptual phase of development, as Klosterman says (1995, pp.29): "the ideal PSS is as easy to define as it will be difficult to implement", both technically and institutionally.

3.1.4 Components of DSS

Many authors describe the elements of which one DS application consists in different ways, although generally speaking each DS application consists of a few fundamental elements: database, model base, DSS generator and user interface.

Database is a collection of facts that can be used as a basis for reasoning and decision making.

Model base contains a model - an object or a concept that is used to represent the real situation, an abstract framework that is well understood. As explained by Bonczek et al. (1981): 'a model is a plan for information processing and provides a specification for transforming information'.

DSS generator is a computer software package that provides tools and capabilities that assist a developer in quickly building a specific DSS (Power, 1996).

User interface is the dialogue manager that assists with all aspects of communication between the user and the hardware and software that comprise the DSS (Power, 1996).

Each of these elements gathers the information in its own specific way, and these ways change over time. In earlier DS systems, for instance, elements were used separately, while nowadays the intention is to couple them together. An example of such a coupling can be seen in the evolution of Geographic Information Systems (GIS) where the latest tendencies are to link the models to a database. This can be done simply through the import or export of data - weak coupling - while much stronger coupling exists where models are embedded within GIS or GIS functions within models (Batty, 1996).

Sauter (1997) gives a more detailed description of four components she considers to be the essential parts of a DSS. These are:

1. Database Management System (DBMS)
2. Modelbase Management System (MBMS)
3. User Interface
4. Mail Management System (MMS)

The *database management system* (DBMS) provides access to data as well as to the control programs necessary to get those data in the form appropriate for the analysis under consideration. It should be sophisticated enough to give users access to the data even when they do not know where the data are physically located. In addition, the DBMS facilitates the merger of data from different sources. Again, the DBMS should be sufficiently sophisticated to merge the data without explicit instructions from the user regarding how one accomplishes that task.

The *model-base management system* (MBMS) performs a similar task for the models in the DSS. It keeps track of all the possible models that might be run during analysis, as well as controls for running the models. This might include the syntax necessary to run the jobs, the format in which the data need to be put prior to running the model (and to put the data in such a format), and the format the data will be in after the job is run. The MBMS also links between so that the output of one model can be the input into another model. Furthermore, the MBMS provides mechanisms for sensi tivity analyses of the model after it is run. Finally, he MBMS provides context-sensitive and model-sensitive assistance to help the user question the assumptions of the models to determine if they are appropriate for the decision under consideration.

As the name suggests, the *user interface* represents all the mechanisms whereby information is input to the system and is output from the system. It includes all the input screens by which users request data and models. In addition, it includes all the output screens through which users obtain the results. Many users think of the user interface as the real DSS, because that is the part of the system they see.

Whereas there is general agreement of the existence of the first three components of a DSS, there is a fourth, relatively new component of a DSS, referred to as the *mail or message management system* (MMS). This component allows for the use of electronic mail as another source of data, modeling, or general help in the decision-making process. Since electronic discussion groups, electronic mail among workers, and other resources are quickly becoming an important resource to decision-makers, they need to be managed and integrated as do other components of a DSS if they are to be a resource for decision making.

Developing his conceptual model for an ideal PSS, Hopkins (1999) names the tools for sketch planning, model building, scenario building, evaluation, lineage tracking, and plan-based action as components of a future PSS.

3.1.5 Types of DSS

There are five major categories of DSS according to Power (2000): Data-Driven, Model-Driven, Communications-Driven, Document-Driven, and Knowledge-Driven DSS. As a most recent addition, the Web-Based DSS category appears, although it is in a way an implementation of all other kinds of DSS through the World-Wide Web.

Data-driven DSS or Data-oriented DSS is a type of DSS that emphasizes access to and manipulation of a time-series of internal company data and sometimes external data. Simple file systems accessed by query and retrieval tools provide the most elementary level of functionality. Data warehouse systems that allow the manipulation of data by computerized tools tailored to a specific task and setting or by more general tools and operators provide additional functionality. Data-driven DSSs with On-line Analytical Processing (OLAP) or data mining tools provide the highest level of functionality and decision support that is linked to the analysis of large collections of historical data. Early, very limited versions of data-driven DSSs were called Retrieval-Only DSSs by Bonczek, Holsapple and Whinston (1981).

Model-driven DSSs or Model-oriented DSSs emphasize access to and manipulation of a model, e.g., statistical, financial, optimization and/or simulation models. Simple statistical and analytical tools provide the most elementary level of functionality. Some OLAP systems that allow complex analysis of data may be classified as hybrid DSS systems providing both modeling and data retrieval and data summarization functionality. Data mining is also a hybrid approach to DSS. In general, model-driven DSSs use complex financial, simulation, optimization and/or rule (expert) models to provide decision support. Model-driven DSSs use data and parameters provided by decision-makers to aid decision-makers in analyzing a situation, but they are not usually data intensive; that is very large databases are not usually needed for model-driven DSSs. Early versions of model-driven DSSs were called Computationally Oriented DSSs by Bonczek, Holsapple and Whinston (1981).

A *Communications-Driven DSS* is a type of DSS that emphasizes communications, collaboration and shared decision-making support. A simple bulletin board or threaded email is the most elementary level of functionality. The comp.groupware FAQ defines groupware as "software and hardware for shared interactive environments" intended to support and augment group activity. Groupware is a subset of a broader concept called Collaborative Computing. A Communications-Driven DSS enables two or more people to communicate with each other, share information and co-ordinate their activities. A Group Decision Support System or GDSS is a hybrid type of DSS that allows multiple users to work collaboratively in groupwork using various software tools. Examples of group support tools are: audio conferencing, bulletin boards and web-conferencing, document sharing, electronic mail, computer supported face-to-face meeting software, and interactive video.

The WWW and intranet infrastructures are important factors enabling development of more powerful Communications-Driven DSSs. The latest software is based on these technologies.

Communications-Driven DSS software has at least one of the following characteristics:

- Enables communication between groups of people
- Facilitates the sharing of information
- Supports collaboration and coordination between people
- Supports group decision tasks

Key research issues for Communications-Driven DSS include impacts on group processes and group awareness, multi-user interfaces, concurrency control, communication and coordination within the group, shared information space and the support of a heterogeneous, open environment which integrates existing single-user applications. Communications-Driven Decision Support Systems are often categorized according to the time/location matrix using the distinction between same time (synchronous) and different times (asynchronous), and between same place (face-to-face) and different places (distributed).

Document-driven DSSs manage, retrieve, and manipulate unstructured information in a variety of electronic formats. This type of DSS assists in knowledge categorization, deployment, inquiry, discovery and communication. The most elementary level of document-driven DSS is a hyperlinked collection of documents such as web pages.

Knowledge-driven DSSs have specialized problem-solving expertise stored as facts, rules, and procedures or in similar structures. The expertise consists of knowledge about a particular domain, and skill in solving some specific problems. Knowledge-based DSSs are sometimes called "expert systems".

A *Web-based DSS* is a computerized system that delivers decision support information or decision support tools to users via a Web browser such as Netscape Navigator or Internet Explorer. The computer server hosting the DSS application is linked to the user's computer by a network with the TCP/IP protocol. In many companies, a Web-based DSS can retrieve, analyze and display structured data from large multidimensional databases; it can provide access to a model or expert system, access to multimedia documents and unstructured data and facilitate communication and decision making in distributed teams (Power, 2000). In general, all types of decision support systems, including Data-driven, Model-driven, Communication-driven, Knowledge-driven and Document-driven DSSs can be implemented using Web technologies.

WWW technologies have created new opportunities for DSS research and for developing innovative decision support systems. There are already many examples of DSS available on the web, some good and some not so good. Therefore more research needs to be done on methods for evaluating web-based DSSs. Most current systems are not systematically evaluated once they are implemented. The role and effects of user involvement in the design and development of web-based DSSs need to be studied too. The web has increased access to DSSs and it should increase the use of well-designed DSSs too. Using web infrastructure for building DSSs can improve the rapid dissemination of "best practices" and it should promote involvement of both actors and citizens in decision making processes.

3.2 The theoretical background of Decision Support Systems

In "real life" there are many occasions when one has to decide, when one is faced with a decision problem. There is no precise definition of what a decision problem is since it is specific for each situation, but according to Payne (1985), most definitions of decision problems include:

1. the courses of action or alternatives available to the decision-maker
2. the possible outcomes and values attached to them, conditional on the actions, and
3. the events or contingencies that relate actions to outcomes (Huber, 1980; Tversky & Kahneman, 1985).

One of the most used theories in attempting to understand human decision making is decision theory. Decision theory concerns the use of reason in human decision making. It is thus based on the concept of rational thinking.

3.2.1 Rationality in Decision Theory

According to Lee (1971), decision theory is based on the quest of social philosophy for an understanding of proper and actual human action in relation to reason. A good deal of the recent work in decision theory concerns the hypothesis that human behavior is, as a rule, rational. In decision theory, a rational man is one who, when confronted with a decision situation, makes the choice (decision) that is best for him. This best decision is called a rational or optimal decision. The properties of a rational decision are:

1. A rational decision is one (or more) of a specified set of possible decisions. A "rational decision" is a "best" or "optimal decision". There may be more than one "best" decision if they are equally good, but an investigator cannot say that unless he knows what the possible decisions are. If they are not known a person has to generate, i.e. think of, possible decisions which he can afterwards evaluate.
2. The rational decision depends on the decision principle (or criteria) employed by the investigator. Whether the decision is judged to be rational or not depends on the principle employed by the investigator. Objective probabilities in some cases would have a bearing on the rational decision, but most often in practice subjective probabilities are employed. It is important to note that the subjective probabilities of two persons can differ without either being wrong.
3. The rational decision for a decision situation may differ among persons. The reasons for this are that subjective probabilities differ among people and people evaluate the possible consequences of a decision differently. The value of a particular consequence to a person is called the utility of the consequence.
4. A rational decision is dependent on relevant information available to a person.
5. A rational decision must be consistent with the person's preferences and beliefs.

The rational man has often been portrayed as one who carefully deliberates and gives thoughtful and well-reasoned explanations for his beliefs or actions. Decision theorists have been little interested in explanations; they judge his rationality not on the basis of the behavior during the process of decision making but on the basis of the decisions he makes. In practice, the rational man of decision theory is close to the economic man who has tried to maximize profits.

Decision theory has a strained relationship with the rationality of human beings. The choice of context, the selection of alternatives and criteria, the preferences and the values of the decision maker are beyond the limits of decision theory and they may be highly irrational.

An examination of the opinions of the great thinkers of past ages reveals that, for the most part, typical human action was supposed to be based not on reason but on ignorance, superstition or the passion of the moment. Other commentators of human conduct argue that human choice is based on instinct, altruism, reinforcement, blind passion, duty, wickedness and moral uprightness.

There is also a huge debate over what neoclassical economists call rational economic man. One position in such theorization is what post-Keynesians, Marxists, postmodernists and feminists call decentered subjectivity and the multiple and contradictory positions of individuals resulting from the social constructedness of behavior and agency.

According to Lootsma (2000), modern brain research has ended Cartesian dualism, the strict separation of body and soul (Damasio, 1995,1999; LeDoux, 1998; Kingsley, 2000, from Lootsma, 2000, pp. 23-24). It emphasizes the essential role of emotions and feelings for decision making. The choice of criteria and alternatives is under the influence of warning signals that come from the lower belly. Lootsma argues that emotions and feelings lead and color rational decision making. As proof for such a statement he names the case of a patient who lost the experience of emotions because of brain damage, and who was still able to calculate, speak, and think logically, but was not able to make decisions.

Rational choices should satisfy some elementary requirements of consistency and coherence. Nevertheless, Tversky and Kahneman (1985) describe decision problems in which people systematically violate those requirements. An explanation of these violations can be traced in psychological principles that govern the perception of a decision problem and the evaluation of options. Tversky and Kahneman use the term decision frame to refer to the decision-maker's conception of the acts, outcomes, and contingencies associated with a particular choice. The frame that a decision-maker adopts is controlled partly by the formulation of the problem and partly by the norms, habits, and personal characteristics of the decision-maker.

It is often possible to frame a given decision problem in more than one way. In the case of multiple frames, a rational choice requires that the preference between options should not reverse with changes of frame. But because human perception and decision are not always rational, changes of perspective often reverse the relative desirability of options. Yet sometimes the changes of frame originate from rational reasons. If, for instance, one has to evaluate cars and if one then switches from small to medium-size cars, one's relative preferences may be thoroughly affected. A change of frame in this case may logically lead to a change of preferences.

3.2.2 Decision theory in behavioral sciences

Decision theory was first developed by mathematicians and economists, but in the course of time it became a psychological discipline as well. Therefore Lee (1971) makes distinctions between mathematical, economic and behavioral decision theory, although these three fields certainly have considerable overlap.

Behavioral decision theory has largely been concerned with the hypothesis of general rationality plus the pheriferalia related to formulate and test the hypothesis. Behavioral decision theory aspires to give an account and explanation of human behavior - in particular human decisions. Generally speaking behavioral decision theory concerns the use of decision theory in conceptualizing and understanding human behavior.

A distinction is often made between normative and descriptive decision theory. Normative decision theory concerns the choices that a rational man should make in a given situation. Descriptive theory concerns the choices real people actually make. In practice the distinction between these two theories often becomes blurred. There is still deep controversy between the normative and the descriptive theory. In general, the normative theory tends to ignore how decisions are actually made.

3.2.3 Studies of individual and situational influences on decision making

According to Wright (1985), there are two directions in the research of decisional variance: cognitive-style research and contingent decision research.

Cognitive-style research emphasizes the decision-maker (the decision-maker is the main source of behavioral variation). Here the following are important:

1. The personality of the decision-maker. For instance people who evaluate with high scores the concepts of authoritarianism, conservatism an intolerance of ambiguity, see the world in "black and white"; they make extreme judgements or responses and insist on a 'yes or no' answer.
2. The cognitive style of the decision-maker. Driver and Mock (1975) have identified two dimensions of information processing in decision making: (1) the focus dimension, which has two extremes – processors who view the data as suggesting a single course of action, and processors who view the solution as multiple; and (2) the amount of information, also with two extremes – a minimal data user and a maximal data user who processes all the available information. By combining these two dimensions of information processing they derived four basic styles: decision style (minimal data, one firm option), flexible style (minimal data, multiple options) hierarchic style (masses of data carefully analyzed to arrive at one best solution) and integrative style (maximal data and multiple solutions). There are also other opinions about information processing styles. According to Casey (1980), individuals categorized as sensors prefer to analyze isolated, concrete details, whereas intuitors focus on relationships of gestalt. The Subjective Expected Utility (SEU) theory of decision making argues that optimal choices under uncertainty are made on two independent dimensions of information: probability and utility. But according to Wright (1985), many studies are implicit in the notion that although people think in terms of (statistical) probability they are not very good at it.

Contingent decision research emphasizes the decision situation (the decision situation is the main source of behavioral variation).

Payne (1985) has identified three major theoretical frameworks for dealing with contingent aspects (task and context effects) of decision making:

1. production systems is more a modeling language than a conceptual framework. A production system consists of a set of productions, a task environment and a working memory. The productions specify a set of actions and the conditions under which they occur. These are expressed as a (condition) - (action) pair, and the actions specified in a production are performed only when the condition side is satisfied by matching the contents of working memory. Working memory is a set of symbols, both those read from the external environment and those deposited by the actions performed by previous products. The set of productions possessed by an individual can be thought as being a part of long-term memory.
2. the cost/benefit analysis assumes that the selection of a particular task environment is, in part, a function of the strategy ability to produce an accurate response and the strategy demand for mental resources or effort (Beach & Mitchel, 1978; Russo & Dosher, 1980). The cost/benefit analysis views choice of strategy in decision making as a conscious process. Benefits could include the probability that the decision strategy will lead to a "correct" decision, the speed of making the decision and its justifiability. Costs might mean information acquisition and computational effort involved in using strategy.
3. the perceptual view by Kahneman and Tversky is expressed in the framing of decisions. They argue that people are often unaware of framing effects, and once they are made aware, they are unable to see a decision problem in a veridical way. The analogy is with nonveridical perception in research on psychological illusion.

3.2.4 Cognitive style and the design of DSSs

There are two considerations of cognitive style which are important for the design of DDSs: (1) the relationship between personality/cognitive measures and decision making and (2) the fact that there are distinct cognitive styles of decision making.

For instance, there are decision makers who delay a decision until there is only one alternative. Others defer a decision to higher authorities. Some decision makers ask for second opinions before they weigh the pros and cons of the alternatives.

On the basis of these prepositions many researchers attempted to develop methods of presenting information or aiding decision making in a way that matched the decisional styles of the decision-makers as far as possible. As argued by Zmud (1979) and Huber (1985), cognitive style research is unlikely to lead to operational guidelines for the design of DSSs because (Huber, 1985): " (1) there are many individual differences related to decision-making behavior, and the task of constructing an empirically-based normative design model that accounts for all their effects is overwhelming, and (2) even if we could build such a model, it would be inapplicable to any one decision-maker because there are individual differences in the nature and extent of association among individual differences". To include the parameter of cognitive style in the design of a DSS Huber proposes: "The DSS design effort should be directed towards creating a DSS that is flexible, friendly and provides a variety of options. If this focus is adopted, the matter of an a priori determination of the user's style as a basis for the most appropriate design becomes largely irrelevant".

3.2.5 Design of Decision-Aiding Systems

Wisudha (1985) takes the viewpoint that an aided decision-making process involves the interaction between decision-makers, decision analysts and computerized decision-aiding systems. Decision aiding systems are based on the theoretical principles of decision theory and their implementation through decision analysis. Decision analysis is therefore defined as a technology that has developed methods of assisting the process of assessing a choice problem. The underlying procedures involve:

1. extracting information from the problem owner
2. aiding the individual or the group of individuals in: examining and structuring the information so as to define the alternatives and the criteria on which they are to be evaluated, and to identify various possible courses of action (strategies) and the resulting consequences (effects)

A number of techniques in development of DSSs are employed to assist the assessment of:

1. the relative values of the various possible consesquences on the given criteria (or measuring of the effe-cts per criteria)[5]
2. the degree of importance of the criteria (or ranking of the criteria)
3. the uncertainties associated with the various courses of action (or testing the decision strategies).

In recent developments in DSS technology, the role of the decision analyst has been incorporated in the computerized system. This means that an automated decision-aiding system should function within the framework of decision analysis. In other words, similar to decision analysis it must aid the decision-maker in clarifying relationships between components and enable him to see how the elicited information progressively contributes to a holistic understanding and assessment of the decision problem. Many models were applied in practice (bootstrapping aids, recompozition aids, problem structuring aids. We consider the most proper model for our case to be that of Bronner and de Hoog (1983). They suggest that a decision-maker's preference values on a set of selected attributes can be mapped onto a database through a "pattern-matching" process so that a list of alternatives can be generated that matches the preference expressed as closely as possible. However, a decision aid that concentrates on a fully automated mapping operation cannot rely solely on a factual database. It will necessary require the use of a database that also captures decision-maker's belief system. The information should be structured in a format compatible with other subprocesses that together make up a decision-aiding system. As a result this model calls for design concepts that are far more complex than those currently implemented in the development of DSSs.

3.2.6 The implementation of decision aids in the design process

Design is a complex interactive procedure that takes place in a multidisciplinary context, with tools that are analogically similar. There are different opinions about how much rational organization is involved in that

[5] The basic model of decision theory proposes U = Sui(xij) where U is the total worth of an alternative and ui the partial utility or worth of an alternative as measured on a single dimension. This means that a complex design may be decomposed, its parts evaluated and then additively recombined to find the worth of the whole (prompting the question: if this is reasonable, is integrity one of the most important qualities of designs?).

process. Some researchers argue that designers grope along, building their solution brick by brick without really knowing what it will look like until it is completed (Mintzberg, Raisinghani and Theoret, 1976), as design is often associated with imagination, intuition, creativity and freedom. Others (Batty, 2000), would argue that a design process goes through a series of formally recognizable steps that are similar to the steps in rational decision making. These are: (1) the phase of preparing the general outline of requirements, (2) the analysis of design tasks, (3) the conceptualization of the design, (4) the development of alternative solutions, (5) choosing an alternative on the basis of selection criteria, and (6) the detailed development of the chosen concept. Whichever concept of these two is accepted, it is inevitable that within the design process there are cycles of evaluation and inference, and moments when the designer has to make a choice. There decision aid systems can be applied in a similar way as in the decision making process. As the specificity of this research is that it deals with the relationship between designs and decision making, it is important to realize that there are points where these two actions intersect.

In the development of decision aids that will be used by designers, it is necessary to bear in mind designers' rich capacity for visual thinking. Therefore in the design of DSSs the implementation of decision theory should be applied in tandem with models taken from design methodology. Finally, it can be summarized that there are three ways to develop decision support systems for (urban) design:

1. DSSs can be developed on the basis of decision theory.
2. DSSs can be based on designers' capacity for visual thinking.
3. DSSs can be empirically constructed, are intuitively built by users themselves or ordered by professionals in computer programming.

In the practice of urban design, in most of cases, DSSs are produced through a combination of these three approaches.

3.3 DSSs and the complexity of spatial planning problems

In attempts to implement DSS in spatial planning, many scholars faced difficulties because of the complex character of spatial problems. Spatial planning involves physical, economic, social and cultural aspects, which often have an unstructured, qualitative nature. Planning processes are also dynamic and changeable in character, which makes them extremely difficult to capture in an overall computer based system. Hence spatial problems can be categorized as a class called 'wicked problems' (Rittel and Webber, 1984) which have the following characteristics:

1. There is no definitive formulation of the problem. Because the systems are large and constantly changing, the person solving the problem does not have all the information needed to understand the problem fully.
2. There is no stopping rule to tell when the problem is solved. The problem solver can never conclusively answer the question "have I done enough?"
3. There is neither an immediate nor an ultimate test of whether the system design is successful. The system design process has unbounded consequences, and there is no way to conduct a comparative analysis.
4. There is no single, identifiable "cause" of a problem. The problem may be a symptom of other problems, and the solution will change depending on how the problem is formulated.

There are different streams in approaching this complexity, but the most scholars are passing through the following phases on their way towards the development of a DSS:

1. Enquiry of the planning process in relation to decision making aids
2. Using models to represent spatial problems and processes
3. Definition of requirements for the future DSS
4. Translation of the requirements into conceptual model of the DSS
5. Physical development of the DSS.

Ideally, if we look at the definition of a DSS generator - a computer software package that provides tools and capabilities that help a developer to quickly and easily build a specific Decision Support System - the job seems to be easy. But the reality is far from that. To reiterate Klosterman's statement (1995, p.29): "the ideal PSS is as easy to define as it will be difficult to implement", both technically and institutionally. In the following chapters we will focus on the general and specific problems which are the permanent subject to be addressed in the development of a DSS for spatial planning purposes.

3.3.1 Spatial planning in relation to decision aids

In the classical view of planning there are three main kinds of activities in planning which can be designate as: policy, design and analysis (Wilson, 1974). Synonyms for these, albeit more vivid (as given by Harris, 1965) are: prediction, invention and choice. These activities form a hierarchical relationship, as shown in Figure 3.2.

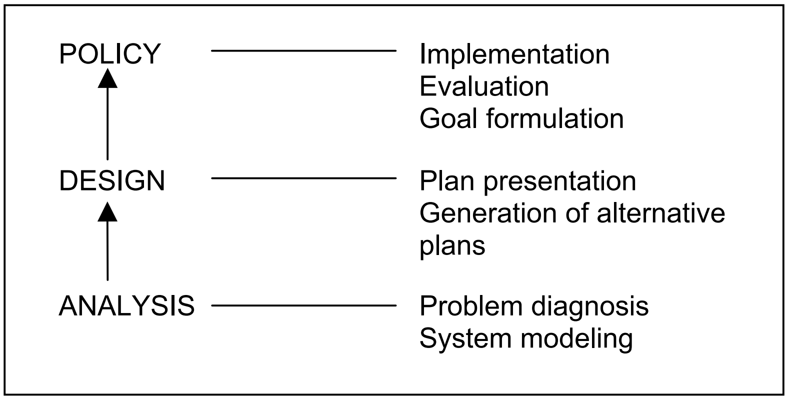

Figure 3.2 The principal planning activities (Wilson, 1974)

The hierarchical relationship arises as follows: the designer needs a good analytic capability so that he can diagnose the problems and predict the impact of his designs; the policy maker needs good design capability to ensure that he really has a good range of alternative plans presented to him, and he needs an additional analytical capability to help establish evaluation criteria for choosing between alternatives. Here it is important to note that a goal may be to solve some particular problem, such as a housing shortage, a lack of recreational facilities, traffic congestion and the like. According to Wilson, the designer's task is to generate alternative settings of the public policy instruments which lead to the achievement of goals (the concept of goal is used to represent the aspirations of individuals and households) and objectives (objectives are the goals of organizations and resources).

According to Reuter (1996), planners produce plans for objects, states or processes in the future. The planning starts when somebody declares that the status quo is insufficient. That implicates the solution. But ideas about the solution are different. So already the definition of the planning problem – as a difference between what is and what ought to be – seems to be impossible. Every planning problem can be seen as a symptom of another one. Every solution is 'a one-shot operation' and irreversible. Every solution is unique, which means that it is not transportable to another problem; some feature will always be different. A test on the correctness of a solution is impossible since the consequences of planned measures lead to infinite causal chains. There are no logical rules or reasons based on data, which lead inevitably and definitively to a solution. The notorious lack of sufficient reason throws the planner back to his ability to judge. If the ought-to-be statements on the basis of judgements determine the planning, the outcome will always be uncertain.

Vriens and Hendrix (1996) see planning as a dynami-cprocess in search of alternative solutions, which cannot be defined a priori. They criticize traditional decision theory because it focuses on how to find a solution for the problems the decision-maker faces. According

Vriens and Hendrix, getting more insight into the nature of the problem forms an integral part of problem solving. Instead of concentrating on alternative solutions for a given problem, they propose to explore ways to envision the decision problem itself. Modeling problems rather than solutions, in flexible and dynamic ways, is necessary because:

1. More than one goal may enter the decision process, possibly obstructing the realization of other goals or conflicting with these.
2. Goals are not stable entities. They may change in the process, they may become more clearly visible, or they may disappear out of sight. Reification of goals should be avoided at any stage.
3. Goals may effectively hide higher-order goals, therefore blurring out 'what we really want to achieve' and introducing the risk of solving problems we do not actually want to solve. This also emphasizes that what we see as a (generic) goal may be a (specific) solution if we establish that the given goal has an underlying justification.

For Wyatt (1996), all planning consists of three stages:

1. Deciding what sorts of plans to formulate
2. Plan-formulation
3. Deciding which plan to adopt

In his opinion, most DSS's focus on the plan-formulation phase, while he is much more concerned with the first and the third phase, giving them the common name 'strategizing'. Strategizing was always regarded as a typical human activity that can hardly be entrusted to computers[6]. But, according to Wyatt, it is theoretically possible to attach a self-improvement mechanism to most decision support systems. Such a mechanism enables the system to learn how to make better recommendations the more it is used. For this purpose neural network technology can be used.

For Ayeni (1996), the planning process should be an interaction between planners, decision-makers and users, because planners do not necessarily have all the knowledge and ability to perform planning tasks alone and consequently should interact more with the people for whom the plan is being made. To achieve this, GIS and expert systems can, according to Ayeni, help a lot.
Another supporter of the use of GIS in spatial decision making is Peckham (1996). A part of all spatial planning is related to environmental management problems, which, according to Peckham, have two main features: they are spatially distributed and multi-criteria problems. In a situation where there is a growing amount of spatial data, GIS can be seen as providing three essential types of facilities: database, graphical display and spatial analysis. For multi-criteria problems, though, GIS is insufficient and has to be linked to some multi-criteria analysis device. In this case the DSS consists of GIS and a Multi-Criteria Decision Aid (MCDA). Such a system aims to provide technologies and algorithms to aid the making of decisions in situations of multiple and conflicting criteria.

Although there has been a large improvement in GIS technologies and the availability of spatial data, there is still a large gap between commercial GIS and requirements which an SDSS or PSS should fulfill. As we have already explained in chapter 2.1.2, there are many definitions of a DSS, but all the recent ones identify a DSS as a combination of database, interface and model components directed at a specific problem. In terms of these definitions, a GIS would not be regarded as a DSS as it lacks support for the use of problem-specific models. A standard GIS can be regarded as an information analysis system, with the spatial database serving as a crucial component. GISs may thus contain information relevant to a decision, but they are general-purpose systems, not focused on a particular decision. For those types of decisions where the standard features of a GIS provide information essential to the decision-maker, a GIS may indeed be a DSS. However, for the full range of problem areas where GIS techniques can make an important contribution, particular problem-related models are needed to fully support decisions. For these areas at least, a standard GIS cannot be said to be a DSS because such a system lacks the support that the use of customized models can provide. For this wide range of second order uses of spatial data, additional processing or integration with non-spatial models is regarded to fully support the decision-maker. As this is not yet the case in the GIS software industry, new extensions have to be built in

[6] For instance, the German philosopher Habermas believes that all human activity stems from three types of human attitude: the philosophical, the political and the dramaturgical. That is, people's planning stems not only from their self-perception and from their ideals, but also from their dramaturgical attitudes – their deepest beliefs and desires. It is the latter that drive hypothesizing, and it is they that are so resistant to investigation and mechanization.

order to transform present GIS software applications into decision support tools.

In discussing decision making on increasing environmental problems, Kaye et al. suggest that "intelligent decisions, based on the most expert knowledge available, will be the cornerstone of ecologically sustainable development". They also realize that many problems require action simultaneously at a number of levels, which requires a dynamic decision-making process that draws together interested parties to the common goal. To achieve such complex goals, Kaye et al. see decision making as dynamic self-regulation. Here they mean that the key in this "self-regulated" environmental decision-making is availability of information and visualization of information. A solution to the problem of the public availability of data, since most information is isolated and available to only a select few, can be seen in the employment of distributed database technology. In the cyberspace age, knowledge is longer centralized and institutional, it is distributed (Dyson et al. in Kaye et al., 1997), and distributed databases support such a concept.

According to Kaye et al. (1997), information must be presented in a meaningful way, allowing rapid identification of problems. Authors think that through "real-time interactive visualization of information, individuals will be able to better identify the issues and participate in effective on-the-ground solutions". Technologies that should help with the visualization of information, according these authors, are GIS, satellite-image analysis and spatial modeling algorithms. The synthesis of all these analytical techniques should result in something comparable to well-known popular computer games such as Flight Simulator and SimCity. As a case study of such an application, the authors give the example of ERIN, Australia's Environmental Resources Information Network (http://www.erin.gov.au). Kaye et al. argue that among cyberspace technologies, the Internet is contributing the most to the dynamic decision-making needed to solve environmental problems.

3.3.2 The modeling of spatial planning problems and processes

Through the 1960s to the 1970s, the growing acceptance of the use of models[7] appeared in order to help planners understand and predict the behavior of urban systems. As Chadwick (1966) has pointed out: "planning is a conceptual general system. By creating a conceptual system independent of but corresponding to the real world system, we can seek to understand the phenomena of change, then to anticipate them and finally evaluate them - to concern ourselves with the optimization of the real world system by seeking optimization of the conceptual system". Although the system approach to planning was very much exploited at that time and later far less used as a concept, we can agree with Chadwick and his followers that the phenomena of change have to be translated into some kind of abstraction, mental, verbal or visual, to be understood, and that all the speculations about the future are based on that abstraction. Therefore modeling is an essential part in both designing an environment as well as designing the systems that represent this environment.

Recent approaches to the modeling of urban problems are very diverse, some of them very theoretical (Reuter, 1997; Wyatt, 1996), and some of them very practical (Batty, 1993). For the purposes of illustration we will present some of them below.

According to Kammeier (1999), modeling was one of the main concerns of planning-related computing in the 1960s and 1970s, but declined in the 1980s when it was overshadowed by GIS applications. The reason for this gap in modeling practice was also that the early models were hypercomprehensive and data-hungry (Lee, 1973), while computer technology was underdeveloped and slow. However, modeling is back Kammeier argues, 'leaner' and more user-friendly, offering the vision of a complete desktop PSS. In his review of a dozen operational models, Wegener (1994) argues convincingly that owing to the urgency of the environmental debate,

[7] A model is a representation of reality. It is usually a simplified and generalized statement of what seems to be the most important characteristics of a real-world situation; it is an abstraction from reality which is used to gain conceptual clarity - to reduce the variety and complexity of the real world to a level we can understand and clearly specify (Lee, 1973)

urban models have been granted a new lease of life (p. 26).

Reuter argues that participants in the planning process bring their interests and try to put them through. They act: they exchange arguments, they deal with the facts, and they make use of expert's knowledge etc. These actions are called pragmatic acts. Reuter focuses on two (although acts might be classified in other ways): argumentation and power acting. Both models are non-technocratic. In discussing planning as argumentation, Reuter refers to Habermas (1973) who argues that ethical norms generally and particularly are valid only if their legitimation can be made reasonable in a discourse for all the participants. Legitimation can be achieved by discourse only if it is free of repression, without restriction in participation, if all the motives except that of a cooperative search for truth are excluded.

Rittel (Kunz and Rittel, 1970) develops his argumentative model on two propositions: first, that the opinion of people involved in planning is ever controversial; and second, that the reasoning of designers, whether individually or distributed across many participants, is argumentative. Rittel developed an instrumental version of the argumentative model. He called it IBIS – Issue-Based Information Systems. It is a knowledge-based system with a special strength in the early planning phases.

In discussing planning as power-acting, Reuter (1997) says that planning is not merely the search for truth; it is more than just the disciplined exchange of arguments with the altruistic aim that the better one may win. During the planning process the parties involved try to influence the outcome. They have interests, which they try to push through, even against resistance.

Argumentation and power acting interfere. Reuter argues that it is necessary to exclude power in order to protect the freedom of decision. The situation of Habermas is ideal – one may approximate but never reach it, and it is an illusion to think that power can be excluded from decision making.

In modeling the planning process, Wyatt (1996) focuses on 'strategizing'. Strategizing involves different actors who use different methods to formulate strategy (see Figure 3.3), but for Wyatt good strategizing needs to be balanced.

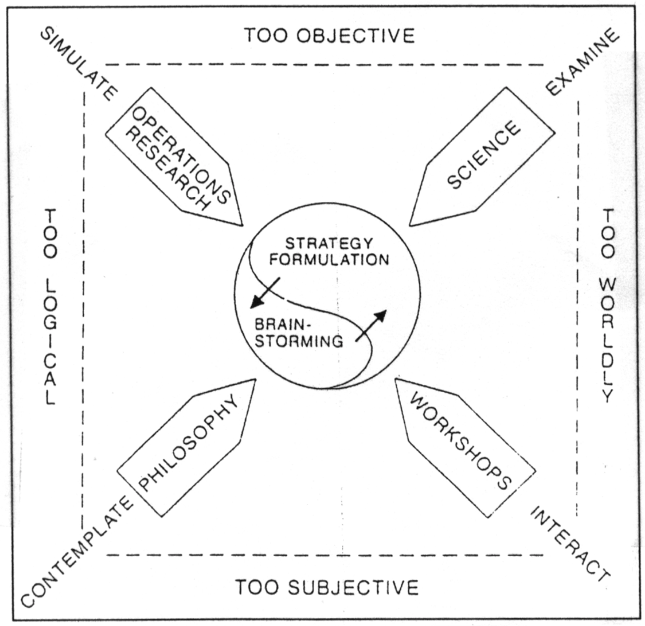

Figure 3.3 Good strategizing (Wyatt, 1996)

Good strategizing is at the intersection of the two axes: the northwest-southeast axis represents 'town' (because most practitioners either simulate or interact with reality), and the northeast-southwest axis represents 'gown' (because most academics spend a lot of time contemplating or examining). Strategizing needs to borrow concepts from all four corners if it is to be performed properly; that is why the four arrows are pointing from the corners towards the middle.

Ayeni (1996) accepts the rational decision-making model of planning. This model assumes that the planning process embodies an analytical phase in which the problem is explored, followed by a synthesis phase in which a solution is devised or generated. Urban models are thus seen as props around which such a rational planning process may be developed. A possible representation of such a model is given by Batty (1995) on figure 3.4 (see at the next page).

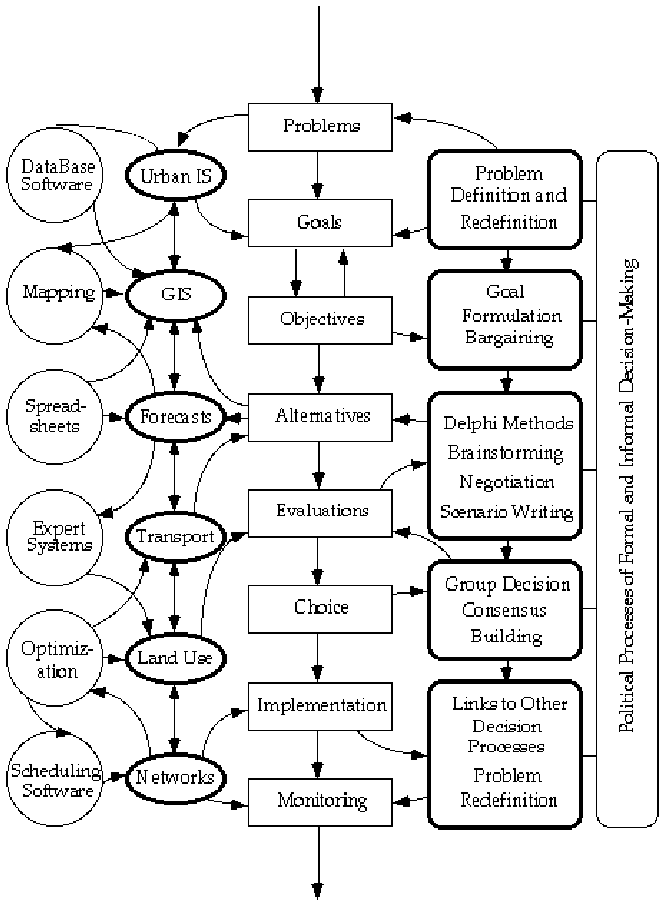

Figure 3.4 Planning support systems incorporating models and information systems (Batty, 1995, p. 13)

The diagram shows a conceptual model for a complete PSS, with the standard cycle of a strategic planning process (small boxes in the middle) as the backbone of a formal desktop system. The diagram connects the computing realm (represented with round and oval bubbles on the left-hand side) with the non-computing realm of the political arena (represented in the squares on the right-hand side). Such a conceptual model summarizes in a sense the needs one PSS should satisfy, and specifies the technical tools for the possible physical realization of a planning support system.

3.3.3 Definition of requirements for a DSS

The third step in the preparation for the realization of a DSS is to define what the system should do in order to function as a decision aid. In this phase, scholars try to put forward some requirements for the future system, which are actually goals to be achieved when the system is developed.

For Reuter, a DSS should fulfil the following requirements:

1. If there are many participants, whose contribution output for the planning process is crucial? An information support system should be open to their contributions.
2. If the view of the problem changes during the planning process, an information support system should have the ability to change its content to grow.
3. If controversy is expected, the support system should be able to represent controversial knowledge, and offer the communication structure to change it.
4. If planning is an exchange of arguments, a support system should be able to enhance or represent argumentation.
5. If the view of a problem changes, new aspects emerge, or if new details become interesting, it should support the tracing and finding of new sources of knowledge, which were unknown at the beginning.
6. If the required knowledge does not fit within the limits of scientific disciplines or political spheres, it should be organized independently of limits.

While Reuter deals with the interaction between actors in the planning process and knowledge issues, Ayeni is more concerned about the technical features of a DSS. Yet in some points both authors agree. Ayeni quotes Densham (1994), who says that a DSS should have:

1. Support for the capture of spatial and non-spatial data.
2. The ability to represent complex spatial relations among spatial data that are needed for spatial query, spatial modeling and cartographic display.
3. A flexible architecture, enabling the user to combine models and data in a variety of views.
4. Methods peculiar to spatial and geographical analysis, including spatial statistics.
5. The ability to generate a variety of outputs, including maps and other more specialized forms.
6. A single integrated user interface that supports a variety of decision-making styles.

7. Architecture that supports the addition of new capabilities as the user needs to evolve.

Sauter (1997) argues that DSS technology is warranted if its role is to help decision-makers do the following:

1. Look at more facets of a decision
2. Generate better alternatives
3. Respond to situations quickly
4. Solve complex problems
5. Consider more options for solving a problem
6. Brainstorm solutions
7. Utilize multiple analyses in solving a problem
8. Have new insights into problems and eliminate "tunnel vision" associated with premature evaluation of options
9. Implement a variety of decision styles and strategies
10. Use more appropriate data
11. Utilize models better; and
12. Consider what-if analyses.

For Turban and Aronson (1998), a decision support system must support:

1. Decision-makers for all kinds of real-life problems, especially for semistructured or unstructured situations.
2. Different kinds of managerial levels.
3. Individuals as well as groups.
4. Sequential or interdependent decisions.
5. All phases of the decision-making process: intelligence, design, choice, implementation.
6. A variety of decision-making styles.
7. Flexibility and adaptability over time.
8. Friendliness for all kinds of users.
9. Effectiveness (accuracy, timeliness, quality) rather than efficiency.
10. Easy construction models.
11. Modeling and analyzing problems.
12. Accessing all kinds of data.

As can be seen, there are many requirements that overlap and repeat throughout the lists of requirements of different authors. Some of them we will also use in the definition of the requirements for our own system.

3.3.4. The design of the conceptual model of the DSS and translation of the requirements into a computer application

Once requirements are defined, the phase of designing the conceptual model of the DSS begins. It involves speculation about the content of the system, its form, behavior, performance, functional components, relationships between components and finally the meaning of the system as a whole.

Laurini (2001) presents a model of a spatial decision support system (Figure 3.5) as a very general scheme of the following sub-systems:

- *acquisition of strategic information*, which is information that comes from the steering subsystem, together with acquisition of information about the territory under control;
- *acquisition of information about the system to control*, i.e. information that comes from the controlled system by means of any kind of acquisition techniques or measuring instruments;
- *a model of the controlled system* in order to project or forecast evolution;
- *modules of what-if models* for data analysis and system simulation;
- *visualization* of alternatives
- *action plans*.

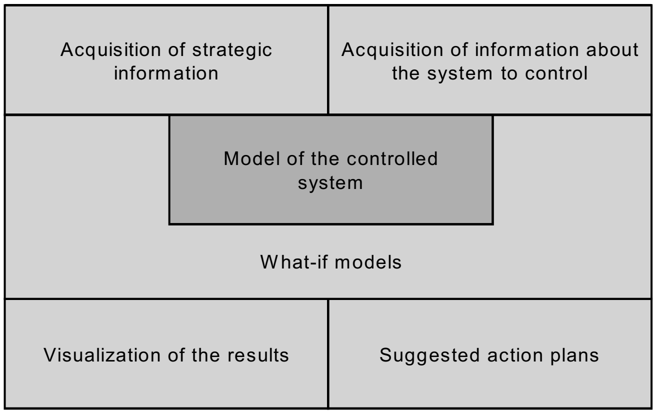

Figure 3.5 Structure of a spatial decision-support system (from Laurini 2001, p.11)

There are a variety of examples and methodologies applied for the design of the conceptual models of DSSs available. One example (Batty's model from 1993) of the conceptual model of a DSS is already presented in Figure 3.3. Another example can be seen in Chapter 4, Figure 4.5, which shows the conceptual model of the 'Sprekend Nederland' DSS. Conceptual models are difficult to completely implement in a computer application because there is no integral platform, so called 'DSS generator' that can be directly used for the construction of a DSS. Rather, there is a variety of approaches to the physical realization of a DSS, ranging from an 'ad hoc' assemblage of several components of different kinds, to the much more structured proto-typing method described in Chapter 6.

In the cases of simple DSSs, a single technology, such as spreadsheets, hypertext documents, or GIS, can already give satisfying results. However, in complex situations, such as in building SDSSs and PSSs, a combination of different technologies is necessary. Often special algorithms need to be developed and integrated too. The technologies mostly combined are database, GIS, 2D and 3D visualization software, multimedia and web software, agent technology and neural networks. The successes of such a DSS will to a large extent depend on the skillfulness of the developer in integrating these loose components. Therefore it often happens that a conceptual model can easily promise too much and give rise to unrealistic expectations among future users. The future developments of information technology will certainly make this problem less marked, but the success of a DSS will always depend on the knowledge and ability of its developers.

3.4 Requirements for the Delta•M DSS derived from the analysis of the decision support systems

This section will present an overview of the tool requirements for the Delta•M DSS. These are derived from the comparative analysis of existing decision support systems presented above. The logical link between advantages, disadvantages and requirements is presented in Table 1.1. In the table, each advantage, corresponding disadvantage and related requirement is marked with the same number (for example advantage no. 1 and disadvantage no.1 are related to requirement no.1 etc.).

Advantages of DDSs

1.	DSSs support rational thinking and thus give more structure to the decision-making process.
2.	DSSs provide information gathering in one place.
3.	DSSs are easily applicable to structured problems.
4.	DSSs are successfully applicable for specific goals.
5.	Modern technology provides the opportunity for the development of complex DSSs that can execute multiple tasks.
6.	The WWW provides new possibilities for the development of DSSs.
7.	GISs can be successfully used in the development of SDSSs and PSSs for spatial data collection and manipulation, and simple modeling tasks.

Disadvantages of DSSs

1.	DSSs do not capture cognitive style and personal characteristics of decision makers.
2.	A lot of information leads to cognitive overload.
3.	DSSs are weak when applied to unstructured and complex problems with a dynamic nature, such as spatial planning.
4.	DSSs are not universally applicable; each new goal requires a new DSS.
5.	Modern DSSs tend to be complicated assembles of different tools, which makes them user-unfriendly and untrustworthy.
6.	Many new WWW applications of DSSs are appearing, and it is difficult to judge their quality, as there are no methods developed yet.
7.	GISs cannot be used for modeling and interaction within complex spatial problems.

Requirements for the Delta•M DSS:

1.	Delta•M should help users to select alternative solutions following principles of rational decision making so as to improve the structure of decision-making processes. But Delta•M should also be sensitive to the needs of the decision-maker and provide assistance based on his cognitive style and personal characteristics.
2.	The Delta•M DSS should employ a computer based 'agent' to prevent users' cognitive overload. • The agent should follow users' preferences and select information on the basis of this.
3.	The Delta•M DSS should be able to capture the complexity and dynamic character of spatial planning processes.
4.	The Delta•M DSS should have a flexible structure so that it is applicable to different planning situations.
5.	The Delta•M system should be user friendly, well integrated, and function as a whole. • The design of user interfaces is extremely important for user friendliness, as most users associate the interface with the system itself. • In the Delta•M DSS, user interfaces should establish common ground between the user and the computer, similar to those that people use in human-to-human conversation. • The reasoning logic of the system should be displayed to the user so as to improve the transparency of the system and to make it more trustworthy.
6.	The system should be implemented via the WWW and tested for its usability. • A testing methodology for WWW-based DSSs should be developed.
7.	The system should combine GISs with other, more intelligent technologies. Integration of models and the requisite modeling technology in a knowledge base of the system is needed for reliable results and the proper functioning of the system.

Table 3.1 The logical link between the advantages and disadvantages of DSSs and the requirements for the Delta•M DSS

The system requirements presented above will be used for the development of the conceptual model of the Delta•M DSS.

3.5 Conclusions

In this chapter we gave a brief overview of the definitions, theoretical background and technical aspects of decision support systems. In addition we focused on the implementation of DSSs in planning research and practice, giving special attention to Spatial Decision Support Systems and Planning Support Systems. Than we have looked at possibilities of DSSs for realization of the citizens' participation and electronic democracy.

It is evident that there are many challenges, arising from both theoretical and practical aspects, which a developer of a DSS might face in his/her work. On the theory side, there is discussion on the controversy between the necessity of information gathering and cognitive overload; between rationality in decision-making and irrational human actions such as instinct, duty, uprightness, ignorance, and power-acting; between objectivity and the subjective characteristics of the decision-maker such as norms and habits. Further on considerations are related to the relationship between problem definition, solution finding, and goals. An improper problem definition, for instance, can lead to a different framing of the problem, and as a consequence a violation of consistency and coherence in decisions can occur.

The automation strategies usually used to build DSSs make them rigid and difficult or even impossible to adapt to the changing character of spatial planning, so the dynamics of the process is often ignored. So another challenge in designing a DSS is how to incorporate the dynamic nature of planning and decision-making into a static pre-designed system. With respect to all the above problems, we can conclude that the design of a universal DSS is a rather overwhelming goal.

It can be generally said that modern DSSs are complex systems, which are meant for more than one task and multiple use. Although the systems can be of a great help to decision-makers, more and more requirements are put on them so they often become too complicated and user-unfriendly. A proper balance between too ambitious data-hungry systems, and too simple generalized systems, is therefore needed to make a successful DSS.

The theoretical roots of DSSs are almost 50 years old, but the biggest improvements in the practical development of DSSs occurred in the last ten years, with the development of home PC computers, advanced software, database technology and computer networks such as the Internet. This technological infrastructure provided new possibilities of applying and testing the theories known from the 1960s and 1970s as well as the development of new theories. As a result, an enormous number of DSS applications appeared in almost all fields of human activity.

One area where DSSs are nowadays very much in use is spatial planning. The specificity of spatial DSSs, known as SDSSs, is that they are basically associated with GIS technologies. Although in recent developments in GIS technology a GIS is not only used as a database for the storage of spatial data, but as the model base as well, there is still a long way to go before it can be used for complex planning problems. For those types of decisions where the standard features of a GIS provide information essential to the decision-maker, a GIS may indeed be a DSS. However, for the full range of problem areas where GIS techniques can make an important contribution, particular problem-related models are needed to fully support decisions. For these areas at least, a standard GIS cannot be said to be a DSS because such a system lacks the support that the use of customized models can provide.

The situation is similar in the field of PSSs. PSS applications, such as "UrbanSim" (www.urbansim.com) or "What If?" (Klosterman, 1999), which are not GIS-based, but can be connected to GIS databases, have received a lot of attention in the last few years. But while they seem to be promising tools for building and accessing detailed urban development scenarios, they are not widely used in planning practice, especially not in Europe. And, although many attempts were made to build an overall useful PSS, there is still no underlying structure which would integrate the loose components of existing systems. Many tools useful for particular planning tasks have been developed. Nevertheless, there is as yet no coherent system that links a wide range of tasks from sketch planning to modeling (Hopkins, 1999). So the real PSS is still only in the conceptual phase of development, as Klosterman says (1995, p.29): "the ideal PSS is as easy to define as it will be difficult to implement both technically and institutionally".

As the most recent in the field of DSS development WWW technologies have created new opportunities for DSS research and opened a new era in development of innovative decision support systems. There are already many examples of different kinds of DSSs available on the web, some good and some not so good. Therefore more research needs to be done on methods for evaluating web-based DSSs. The web has increased access to DSSs and it should increase the use of well-designed DSSs too. Using the web infrastructure for building DSSs can improve the rapid dissemination of "best practices" and it should promote the involvement of both actors and citizens in decision-making processes.

Looking at the 'state of the art' of existing DSSs from the point of view of the theory of citizenship, pluricentism and electronic democracy, we can conclude that there are currently only the first steps towards such systems have been taken, but there is no example in spatial planning practice which can completely accommodate these theories.

The vast majority of decision support systems are built as stand-alone applications, aimed at professional users, and therefore they are restricted in use and available only to a small number of people.

In the last few years many attempts have been made either by governments or by citizens' groups to provide information either about spatial planning in general (for example the web site of the ministry of VROM, www.minvrom.nl) or for specific cases of spatial plans (the web site of the municipality of Amsterdam, or the website of the Masterplan Zuidas, www.zuidas.nl). There are also many Internet discussions currently in progress about spatial planning, and there are sites where citizens are invited to give their opinion about a plan via e-mail (for example the Internet site of the Fifth National Document on Spatial Planning, or the web site: www.vpro.nl/programma/openplek). Although the web-based DSSs for spatial planning do not exist in practice, these first steps in the partial use of the worldwide web for the promotion of electronic democracy are the first steps towards more serious applications which will come in the near future.

By this considerations we have completed the part of the text that relates to the theoretical framework of this research. In the next chapter we will present the empirical framework which is derived from the case study research.

Part three –

Empirical framework

4. The Case Study Approach

4.1 Definitions

The basic idea of the case study is that one case (or perhaps a smaller number of other cases) will be studied in detail, using whatever methods seem appropriate. The general objective of a case study is to obtain as full an understanding of that case as possible.

A case study is generally regarded as a qualitative research method[1]; it aims to understand the case in depth, in its natural setting, recognizing its complexity and its context (Punch, 1998). It also has a holistic focus, aiming to preserve and understand the wholeness and unity of the case. Punch (1998) considers the case study to be more a strategy than a method.

A dictionary of sociological terms defines a case study as a method of studying social phenomena through the analysis of an individual case. The case may be a person, a group, an episode, a process, a community, a society or any other unit of social life. All data relevant to the case are gathered and all available data are organized in terms of case. The case study method gives a unitary character to the data being studied by interrelating the variety of facts to a specific case. It also provides an opportunity for intensive analysis of many specific details that are often overlooked with other methods. The case study approach rests on the assumption that the case being studied is typical of cases of a certain type, so that through intensive analysis a generalization may be made which will be applicable to other cases of the same type (Theodorson, 1969).

[1] Many case studies will use sociological or anthropological field methods, such as observations in natural settings, interviews, and narrative reports. But they may also use questionnaires and numerical data. This means that the case study is not necessarily a qualitative technique, though most of the studies are predominantly qualitative.

Yin (1988) identifies several types of case studies: single case or multiple case studies with an explorative, descriptive or explanatory character. The generalizations that result from the case study (or studies) can often lead to theory development. Yin 's (1981a, 1981b) definition is as follows:

> "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and multiple sources of evidence are used".

In general, case studies are the preferred strategy when "how" and "why" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context (Yin, 1988).

4.2 The aim and selection of the cases

The aim of the case studies in this research was to explore four examples of application of new methods of decision making and information communication technology[2] (ICT) in the practice of spatial planning. The cases were: the Metropolitan Debate (*Het Metropolitane Debat*, HMD), Masterplan South Axes (*Zuidas*) Amsterdam, the Deltametropolis project of the 'Architectural intervention' and the project called 'Open Place' (*Open Plek*). Each of the four examples is different and specific in either its method, implementation of ICT, or spatial planning context. In the following sections we will explain the reasons for the selection, the method of data collection and analysis, and the achievements of each of the cases. Through analyses of strengths and weaknesses of the cases we will gain knowledge that will be used in the development of the Delta•M DSS.

In the general conclusions of this chapter we will present the findings that are derived by putting the case studies in relation to the theoretical framework of the research. We will also look at the use of DSS in the

[2] Here we are talking about ICT instead about DSS, because only in the case of HMD a complete DSS was implemented. In the rest of the cases we ate talking about application of Internet in the decision making.

case of HMD and its meaning for the development of the Delta•M DSS.

4.3 The case study of the Metropolitan Debate

The case of the Metropolitan Debate (HMD) is about the implementation of a new method for decision making in the spatial planning of the Netherlands. The method was designed and tested seven times by the Association with the same name – HMD. The case is selected because it is based on critics of current decision making procedures in spatial planing: its inefficiency expressed in slowness and the low quality of decisions. Additionally, the case is selected because it uses a DSS as part of the method.

The HMD case is unique in spatial planning practice in the Netherlands in the sense that it proposes radical changes in the view of how decisions should be made, applying the changes not only to sectoral policy and procedures, but also to integral spatial problems. The HMD Association has dual goal - the development of the HMD method, and the development of spatial perspectives for the country or its parts – the principle interest of this research is focused on methodological issues. The implementation of the DSS is treated as a special sub-unit of the case.

Within the case study quantitative methods were used to examine the opinion of the participants in HMD debates about the new method.
For the purposes of this study – the development of the prototype of the Delta•M DSS – the knowledge generated through observation, direct participation and survey about the method and implementation of the DSS were more important than the outcomes of the debates.

The knowledge obtained through the HMD case study was used for the formulation of the requirements for the Delta•M DSS.

4.3.1 What does decision making look like according to the HMD method?

In this section we will give a short introduction to the HMD Association, followed by a description of the new decision making method the Association developed over the last few years. By analyzing the method and its implementation in several 'test' debates, we will focus on methodological problems, adequacy criteria and basic concepts of the integration of the DSS in the decision making process.

4.3.2 Introduction to HMD

In 1995 an idea was born at the Delft Faculty of Architecture to transform the existing broad and chaotic discussions about the urbanization of the Netherlands into a better-structured metropolitan debate. The *Het Metropolitane Debat* Association was established by six professors from the Universities of Delft and Amsterdam with the aim of initiating broad public debate about the future development of the Dutch metropolitan area and the role of physical planning in the shaping of the land. The founders of the HMD were critical of the current spatial development policy and the methods used in decision making. Therefore the thoughts of HMD went into three directions:
faster decision making about large spatial projects
a new urbanization concept for the Netherlands
an open planning process

In a two-year period (1996 to 1998) the HMD Association organized several debates in order to answer these questions. The debates involved about 700 professionals, politicians and citizens from different parts of the country. In the course of that time a new method of decision making was developed, implemented and evaluated.

The original ambition of the Association was to develop a method which would be robust enough to completely replace the current legal procedures of decision making about spatial plans. But as the method was being developed by professional planners and designers, it was lacking in juridical aspects and therefore the Association changed this ambitious goal. Finally the method was developed as an addition to regular decision making procedures, with the aim of improving and accelerating them.

The Association has developed the method as a simulation of reality so that it can be exercised, and through those exercises improved. The basis of the method is a pluricentric decision making model where representative democracy holds the central position.

4.3.3 Description of the HMD method

The HMD decision making method consists of (1) an exploration of the subject of the debate (such as plans for The Netherlands 2030, development of rural areas etc.), and (2) developing the three-phase structure of the decision making process.

(1) Each HMD debate is preceded by an exploration of the subject of the debate, which consists of four components:

1. *inventarization* of existing spatial perspectives/ projects
2. *analysis* of spatial perspectives
3. *re-design* of the perspectives in a specific way, so that they become comparable
4. development of new *strategies*, which is a very important step in the HMD method. A strategy consists of a future social-political perspective in combination with a 'portfolio of projects'.

Perspectives are coherent and holistic visions of the future development of the whole area that is the subject of a debate. Projects are in field, extent and location clearly defined spatial interventions, their investment value is defined, and their financial profit is or could be known. A portfolio of projects is a collection of projects selected from a pool of actual and potential projects (Frieling, 1998) A perspective and a portfolio of projects together make a strategy that is the essential input for the simulation game that is used in the second step of the HMD decision-making procedure.

(2) In the first six debates the decision making model presented in Figure 1 was used. The three-phase decision making model is, according to Frieling (1998), a succession of three phases: individual opinion forming, negotiation and debate (see Figure 4.1).

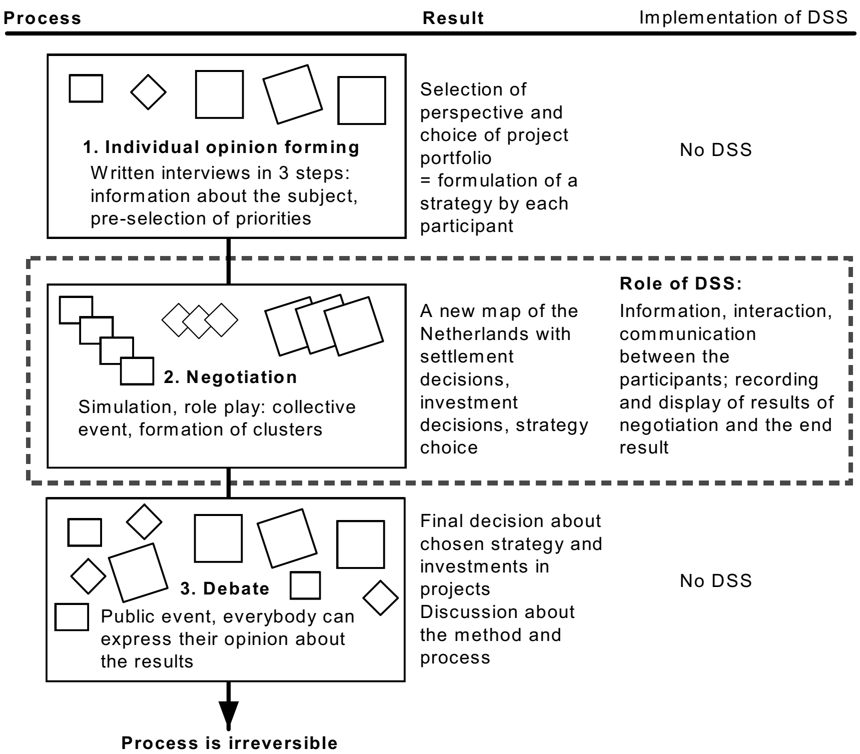

Figure 4.1 The decision making model of the HMD method that was implemented in the first six debates

Individual opinion forming or personal positioning is aimed at informing each participant about the subject of the discussion. It is done by a series of usually three written questionnaires, which are designed to direct the participant's attention to certain problems and prepare him for the forthcoming negotiation and debate phases. Three to four questionnaires are sent in the course of a few weeks, and each time all responses to the questionnaires are statistically processed and the results reported back to the participants.

After the participants have been individually prepared, the negotiation phase can begin. It is a one-day event when all participants get together to take part in the simulation game. The simulation represents the real decision making process with different agents involved such as planners, politicians, investors, citizens, businessmen and so forth. Each of the participants is given the means to manipulate the game in the form of money, time and votes. The crux of the method is that the participants in the negotiation have to make decisions taking three different roles: (1) as inhabitants (consumers of the space) that have to decide where they would like to live (settlement decisions); (2) as citizens who are, together with other citizens, responsible for political decisions; and (3) as agents that play a roll in the economic process of implementing the projects (investment decisions). In this way future perspectives are made concrete through project portfolios and conversely, the projects are permanently tested on the basis of the future perspectives. The idea of the method's founders is that through these three roles each person should find his way in modern society (Brouwer, 1998).

In the debate phase, all the participants discuss and evaluate results of their negotiations, the choice of strategy and decisions on where to settle[3].
The result of the negotiation phase consists of:

[3] In the first three HMD debates, the discussion took place on the day of simulation. In the last debate, 'Nieuwe Ommeland", the discussion was moved for two weeks after the simulation. The reason was that developers of the method realized that both participants and themselves are to tired and impressed by the simulation that it is better to take some time distance before making final decisions and conclusions about the method.

1. a future map of The Netherlands with the settlement decisions of participants;
2. a future map of The Netherlands which represents the project decisions of the participants (Figure 4.2);
3. strategies with their additions: (adjusted) perspective, (adjusted) portfolio and number of votes in favor;

representation of the chronological order of all decisions taken; and

presentation of the results of the questionnaires.

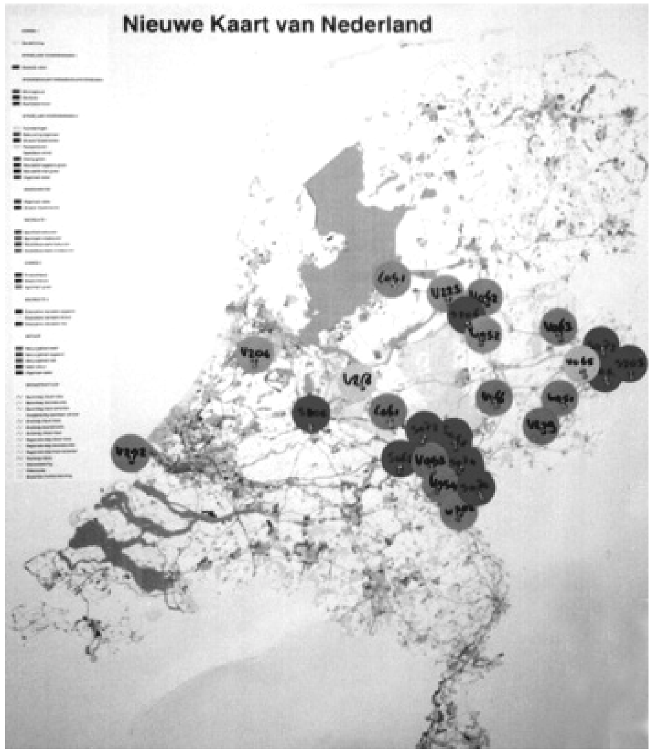

Figure 4.2 The Status map – The New Map of the Netherlands - the result of the 'Windstreek' debate in the eastern part of the country

The last debate that the Association organized was *'Het Nieuwe Ommeland'* and it was devoted to the development of the rural area. In this case the method was improved (Figure 4.3) by postponing the debate for two weeks after the negotiation phase so that participants had time to rethink their decisions. Organizing the debate in the parliamentary form also improved the structure of the method.

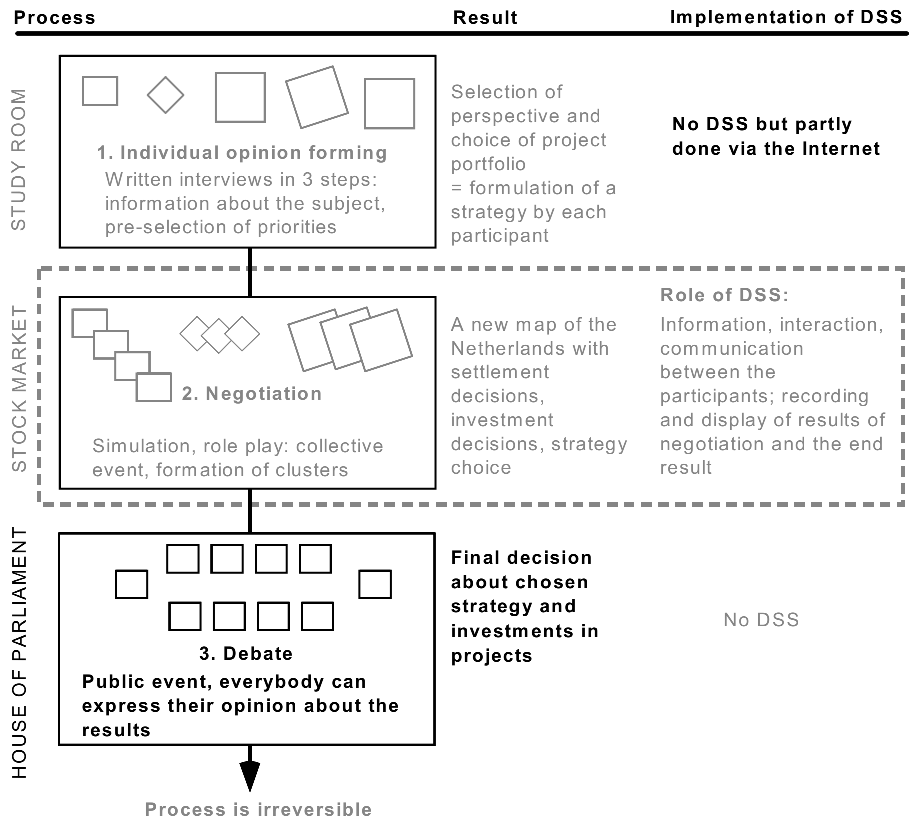

Figure 4.3 The decision making model of the HMD method that was implemented in the last debate, *Het Nieuwe Ommeland*

According to the expectation of the method's founders, this methodological approach should help the decision-making process proceed faster and better. The foundation suggests that the method could help in formal public decision procedures as a complement to legal procedures because it gives an opportunity to citizens, representatives and managers to practice and rehearse before they take final decisions.

4.3.4 Design of the case study

According to Yin (1988), "the design of the case study research is the logical sequence that connects the empirical data to a study's initial research questions, and ultimately, to its conclusions. Colloquially, a research design is an action plan for getting from here to there…"

Philliber, Schwab and Samshoss (1980) argue that the research design deals with at least four problems: what questions to study, what data are relevant, what data to collect, and how to analyze the results.

This case study is designed as a single case with one sub-unit of analysis. The main unit is the HMD method as a whole, and the sub-unit represents the development and implementation of a DSS as a part of the method.

The data was gathered from documentation of the HMD foundation, observation of debates and organizational meetings, direct participation in the process of implementation of the HMD method and a survey of debate participants. For the analysis of data special criteria were developed on the basis of the theoretical background of this research.

Most of the observations and the survey took place during the first of the four debates: *'Debat der deelnemers'*, which took place in the New Metropolis in Amsterdam in June 1997. After the debate we asked participants to complete a written questionnaire consisting of 38 questions. The questionnaires were used for the analysis and evaluation of the HMD method.

The questionnaires consisted of seven sets of questions:

1. Three general questions which concerned backgro-und information about the participants,
2. eleven questions about the first part of the HMD method – the written interviews,
3. nine questions about the simulation game on 6 June,
4. four questions about the results of the process.
5. three general judgements,
6. seven statements about the HMD method, and
7. One open question about the experiences with the method and further suggestions.

The total number of participants in the Debate der Deelnemers was about 200 people. 109 of them retu-rned the questionnaire. From the analysis of those questionnaires we could see that 104 of the respondents were involved in the Debat der Deelnemers from the first interview, and 83 participated in all four rounds of the written interviews.

The professional structure of the participants was mostly represented by non-economic instances. 77.1% of the participants were from research, educational, or cultural instances, then there were representatives of public authorities, civil servants, designers, professi-onals in spatial planning, farmers, and one housewife. The participation of economic instances was relatively low – only 22.9% participants were from firms and busine-sses.

The geographic origin of the participants was mainly from the western part of the Netherlands. 69.7% live in the west of the country and 73.8% works there. The intention of the HMD Association to attract an even number of participants from the whole country did not really succeed.

The *'Windstreek debat',* which took place in Arnhem in the winter and spring of 1998, was the subject of observation and also direct participation, but to a much lesser extent. The analysis of this debate is mostly based on the findings of Teisman (1998), who evaluated the method at that time. The analyses of the last debate, *'Het Nieuwe Ommeland,'* are based on the documentation for the debate and the evaluation of the results published by the HMD Association.

Generally speaking, the participants in the HMD simulations were professionals, selected by the HMD Association in order to represent all parties that are usually involved in spatial decision making. They are: public authorities, architects and urban designers, representatives of citizens' organizations, universities, monument and nature protection organizations, museums, businesses, firms, banks, and so forth. The Association also tried to involve an approximately equal number of participants from all parts of the Netherlands. In each of the seven debates about 100 to 200 people participated. In the case of the "Nieuwe Ommeland" debate, special attention was given to the involvement of the agricultural sector, government (state, provincial and municipal) and users of rural areas (organizations which deal with the environment, nature and recreation).

The power position of the participants was equal and determined by the amount of financial or legal means they had at the beginning of the simulation game.

4.3.5 Case study questions

The main proposition of the HMD foundation is that the HMD method can improve the procedures currently used for decision making about spatial plans and can shorten the time needed for the process to be completed. The research hypotheses posed in this case study are:

1. The HMD method improves decision making by shortening the time needed for decisions to be adopted.
2. The HMD method improves the results of decision making.
3. The HMD method stimulates an open planning pro-cess.

In the following chapters the first two general propositions will be split into several sub-questions in order to analyze the case better. As the open planning process is, in the scope of the HMD, a condition for the first two propositions to be realized, it will be discussed as a part of them.

Proposition 1: The HMD method shortens the time needed for the decision making procedure

One of the most important reasons for the development of the HMD method was the dissatisfaction of the HMD founders with the slowness of current decision making procedures. They claim that the HMD method should lead to better decisions in a much shorter period of time. This can be achieved through an open planning process and interactive decision making. According to the HMD Association, by using their method to practice and debate before taking decisions, the speed of the legal procedure will improve.

To give an insight into the duration of the procedures currently used for the approval of the national spatial planning policy document (*Nota over de Ruimtelijke Ordening*), we have presented the phases and their steps in Figure 4.4. We use this analogy because the HMD method was initially conceived as an alternative to this procedure, as the scope of the debate was the development of the spatial Netherlands as a whole. The HMD method was used for several large-scale debates which preceded the Fifth National Spatial Planning Policy Document, and finally it was used in the preparation of this document too.

The national spatial planning policy document follows a set procedure called the national spatial planning key decision (*Planologische Kernbeslissing*, PKB).

This procedure was first applied on an experimental basis in the early 1970s, but only became law in 1986, in the revised Spatial Planning Act (*Wet Ruimtelijke Ordening,* WRO).
In accordance with this procedure, following the initiative of the Council of Ministers (*Ministerraad*), central government publishes policy proposals (the National Spatial Planning Agency – *Rijksplanologische dienst*, RPD - prepares a spatial planning policy document).

These proposals (part 1 of the procedure) will be given extensive publicity. They will be put on public display and reactions are invited from the general public. Anyone has the opportunity to participate in the process. The policy proposals are also submitted to the First and Second Chambers of the Dutch parliament. At the same time Ministers responsible consult with the lower tiers of government, usually involving the provincial authorities, the water boards, and whenever possible the municipal authorities. The Advisory Council for Spatial Planning (*Raad voor de Ruimtelijke Ordening*) is requested to make recommendations. The Second Chamber of parliament can also announce its initial reaction at this stage by means of written questions. The results of this public participation and all these consultations are published as part 2 of the procedure. On the basis of participation, consultation and the advice recommended, the government reconsiders its proposals and then makes a decision, in which it indicates which changes have been adopted, which have not, and why. At this stage the National Spatial Planning Commission (*Rijksplanologische commissie*), which has been involved since the start of the process, passes its judgement on the revised proposals. This government decision is then submitted to the Second Chamber for approval (part 3).

After a debate on both parts 2 and 3 in the Second Chamber, and provided it is approved by the Second Chamber, the decision is put before the First Chamber for approval. The First Chamber is only empowered to approve or reject the decision in its entirety. Once this procedure has been completed, the approved text forms the basis for the policy the government intends to pursue in spatial planning (part 4).

Since January 1994, a spatial planning key decision can be made legally binding.
Figure 4.4 (at the next page) shows the steps and the duration of the procedure of adopting the National Planning Key Decision.

Because of the ambiguousness of this overview[4], it is difficult to calculate precisely the duration of the procedure for a PKB, and we can only estimate that theoretically it should be somewhere between 18 and 21 months. Just to give a general idea, the current policy document, the fourth (*nota*), was first published in 1988 and finally approved by parliament in 1993.

[4] The overview of the procedure is based on the last changes in the WRO, 3 April 2000.

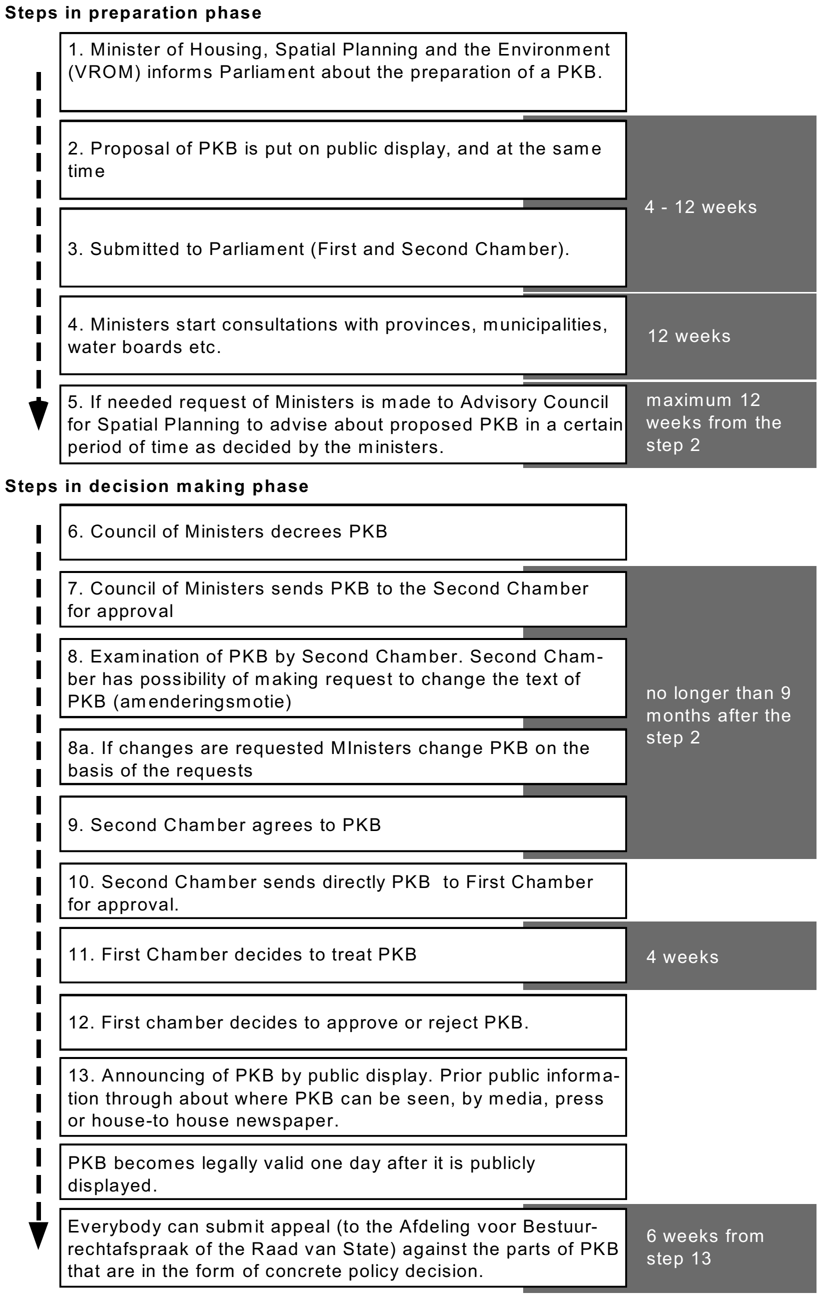

Figure 4.4 Procedure for the national planning key decision (PKB) [duration is between 18 and 21 months]

Analytic generalization[5] of proposition 1

Now, looking at the duration of the HMD procedure, which is presented in Table 4.1 (see the next page), we can conclude that the HMD method is indeed a shorter way. The duration of the debates varied between 5 and 9 months, including the inventorization phase and adding time for postproduction of the documents. Concerning efficiency, and bearing in mind that HMD is a very small organization, the budget and the manpower employed for the preparation, hosting

[5] In analytic generalization (Yin, 1984/1989) a previously developed theory is used as a template against which to compare the empirical results of the case study.

	Name of the debate	Start of the inventorization phase	End date of the debate	Postproduction (reports, work conferences)
1	Het Debat der Deelnemers	January 1997	6 June 1997	September 1997
2	Ontwikkeling Oostflank Stedenring	April 1997	14 November 1997	November 1997
	Windstreekdebatten Nederland 2030			
3	Regio West	November 1997	16 February 1998	
4	Regio Noord		18 February 1998	
5	Regio Oost		19 February 1998	
6	Regio Zuid		20 February 1998	March 1998
7	Het Nieuwe Ommeland	March 1998	2 October 1998	October 1998

Table 4.1 Duration of the HMD debates

and organization of the debates were incomparably lower than in an official PKB procedure.

Proposition 2: HMD method improves the results of decision making

Compared to the regular procedures, the HMD method tends to improve decision making by introducing several elements into the process[6]. These are:

- splitting the decision making process into 3 phases: interviews, simulation game and debate;
- using written interviews to prepare the participants for the negotiation phase;
- bringing all the participants together for the simulation game;
- giving participants several roles at the same time;
- making causal relations between wishes, projects and perspectives;
- offering broad information about the projects and perspectives; and
- implementing a DSS in the negotiation phase.

In the following chapters we will analyze these new elements and try to evaluate their effect on the improvement of the decision making process.

[6] The background of these improvements is the HMD approach - the debate of competent citizens and pluricentric model of decision making.

4.3.6 Analysis of elements of improvement

Splitting the decision making process into 3 phases
As was already described in the previous chapter, the HMD method consists of three phases. In the first phase, called individual opinion forming, participants answer the questionnaires, the set of 3 written interviews. In the second phase, the negotiation phase, participants make their investment decisions by the means of the simulation game. Phase 3 is the closing debate where participants discuss the results of the negotiation process.

Interviews

In the phase of individual opinion forming, participants have to answer three questionnaires, each with about 10 multiple choice questions. The subject of the first interview concerns desirable and expectable social developments, the second is about the spatial qualities and desirable projects and the third is about operational values and investment priorities.

In the case of *"Debat der Deelnemers"*, 76% of participants answered all four questionnaires, and more then half found it useful as preparation for the simulation game. In the debate *"Het Nieuwe Ommeland"*, where only three rounds of questionnaires were held, 77% of the participants completed all the lists. Thanks to interviews, participants were informed about the subject, and even those who were not familiar with the subject or had no specific knowledge of spatial planning could participate in the simulation. The list of projects did not need to be explained at the beginning of the simulation.

One shortcoming of this phase was that many participants felt that the two hours allocated to answer the questions was too long. For them it was also very time-consuming to keep track of what they had written in previous questionnaires. And another very important shortcoming is the absence of interaction between participants in the interviews (see Figure 4.5 on the following page). The interaction only occurred between the organization and participants, in the form of reporting back the summary results of all the interviews. The results of the interviews only had an indirect and in very slight extent influence on the outcomes of the simulation and debate. Therefore participants did not consider it to be an integral part of the method. According to Teisman (1998), "The interviews have cognitive value for the respondents and the organizers of the simulation, but are deficient in an interactive value that will be manifested in the simulation and in the in-depth conduct of the discussion during the closing debate".

The simulation game

After the phase of written interviews has been completed, the participants are invited to come to a special location, where during a one-day meeting they will take part in the simulation game and the closing debate.

By coming to the meeting every participant is assigned one of several possible roles[7]: public or private project developer, public or private financier, public permission issuer and member of the citizens' committee. In addition to a professional role every participant gets the role of an ordinary citizen, who expresses his/her priorities by choosing locations for where to live and where to work. A certain number of game leaders are involved too, such as a strategist (who can give explanations about spatial perspectives), an expert (who can give information about projects), and the game leaders. The simulation results in a list of projects that are provided with building permission, sufficient financial means, and the social support of all the participating groups. This list is presented in the form of symbols on the map of the Netherlands, so that its spatial distribution is also visible.

The simulation begins with an estimation of individual preferences of the participants. Every participant gives his preferences in his multiple role of citizen, inhabitant and actor in the decision making process about, respectively, the spatial perspective, his own housing and work place and desirable projects. Then the game begins.

The essential elements of the simulation game are: the conduct of the game, the computer system[8], role model and players, means of the game, beforehand programming of the projects, and the relation between perspectives and projects.

Multiple roles and role-play

The use of role-play in public decision making is relatively new and not yet broadly represented in practice. In that sense the HMD method is an innovative attempt to bring decision-makers together and provide them with the means for the direct confrontation of interests. By introducing multiple roles, HMD intends to teach participants about their often hidden intentions, which makes the HMD method much more realistic than traditional administrative or professional meetings. There, actors are supposed to hide the confrontation between their individual preferences and the behavior that is expected from their professional role in decision making. As Teisman (1998) comments: "the HMD method is valuable because it puts multiple roles in the simulation and incorporates a market approach into the decision making. As an assessment simulation it is also satisfying. The tension between individual preferences and correct collective decision making is properly shown". However, at this stage of development the HMD method does not give enough insight into how to handle this tension. Nor does it give enough insight into mutual interdependencies.

[7] The roles were different in different debates; here we name the roles in the "*Windstreek*" debate.

[8] The computer system *"Sprekend Nederland"* will be explained in Section 10.

HMD organization

Participant in HMD

asks questions
(general)

replies to questions

asks questions
(projects+perspectives)

Replies to questions
(gets indication of his position in the overall opinion of the whole group of participants - statistics of responses to questionaries presented by HMD)

offers strategies

chooses strategy
(=decision where to invest)

HMD manages all the input and output information, processes the questionaires and informs participants about the global situation. HMD transforms the strategies on the basis of the answers of participants.

HMD wants to know:
- investment priorities of participants
- strategies of the participants

Participant is fully dependent on the selection of information and its interpretation by HMD. He/she cannot directly interact, or choose some other information. Only indirectly and retroactive he/she can see his/her position within the collective result.

Participant has to decide:
- in which projects he/she will invest
- which strategy he/she will choose

he/she has to know (that is available):
- which projects are available
- costs of each project
- profit each project brings
- which perspectives are available
- which projects fit in which perspective and other way around
- relationship between perspectives

not available:
- consequences of chosen strategies on the basis of impact assessment

Figure 4.5 Interaction between participants and the HMD organization during the phase of written interviews

Decision making is, in terms of HMD, executed in a series of decisions taken by different parties, which through interaction determine the final outcome. This way HMD simulates the relative chaos that is characteristic of spatial decision making. Still open to discussion is whether the roles represent reality properly, whether they are functionally defined, whether they are properly assigned to participants and so on. In fact, the compilation of participants has considerable influence on the result of the simulation. In the case of the HMD simulations the participants were to a large extent professionals. Therefore it does not give too much of an insight into what the situation would be in reality, as would be the case if ordinary citizens formed the majority of participants in the simulation game.

The HMD method devoted significant effort to developing the means of the game: money, permissions, vetoes and referenda. These make the game dynamic and unpredictable, but on the other hand are not flexible enough to encompass all the transactions that can occur during the negotiation process.

Information about the projects and perspectives

According to Teisman (1998), the HMD method tends to "pre-program projects in a context of complex decision making with an unknown future". This means that the list of projects offered as alternative choices to participants consists of the projects that are collected through the inventarization of the existing project documentation of various producers (such as the state, provinces, municipalities, design offices etc.). The choices are therefore based on the projects that were developed in the 1980s and 1990s, with no possibility for the participants to influence or change them. This makes the result rather predictable. Teisman concludes that the HMD method "despite the selection of projects from the preprogrammed list, does not provide enough initiative for project innovation and confrontation of different projects". This is the first weakness of the HMD method.

The relationship between perspectives and projects

One of the most important innovations of the HMD method is that it plots the relations of expected social developments (facts), strategies/perspectives (wishes) and projects (behavior). In current decision-making practice this is not the case and decisions are usually made about one project or perspective, without putting them in relation to each other or others of their kind[9].
Teisman notes that during the simulation in the 'Windstreekdebat", the desires got more weight than the realistic expectations about the future. This means that the wishes beat the facts and the simulation could not mend the divide between desires and real social developments. The question is if policy makers notice this obvious inconsistency between their political wishes and the social developments they themselves expect.
The excellent idea of connecting spatial interventions of different scale in a causal relation needs to be technically implemented better. It was very difficult for the participants to estimate the interaction between projects, perspectives and facts in the very short time they had during the simulation. This is the second weakness of the HMD method[10]. Teisman therefore concludes that the HMD method should be worked out as a simulation that flows through different decision-making rounds and decision-making channels. One meeting that is insufficiently defined cannot compete with real decision-making procedures.

Debate

In the closing debate the participants are invited to express their opinions and give their comments about the end results. There are still some changes in the end result possible but the debate is mostly used for critical reflections about both the result and the process. According to Teisman (1998), the closing debate has a 'hybrid' character. During the debate discussion concerns the list of projects, issues of spatial planning in general and the new method. This all goes on in an unstructured form. In discussing the "*Windstreek*" debates, Teisman remarks that "from all parts of the

[9] Here we do not refer to the regular 'checkups' that government does with the horizontally and vertically related plans.
[10] Both weaknesses are mentioned in the Policy Plan of the HMD Association from 1998 (Het Metropolitane Debat Beleidsplan 1999-2000).

HMD method this is the most unclear one. It needs to be further specified". This part of the method is, however, considerably improved in the *"Het Nieuwe Ommeland"* Debate. Dividing the time of the negotiation process and the debate on the results over two weeks gave participants an opportunity to re-think their decisions and correct the end result during the debate. The end debate was also improved and better structured by organizing it in the form of a parliamentary debate, as presented in Figure 4.6.

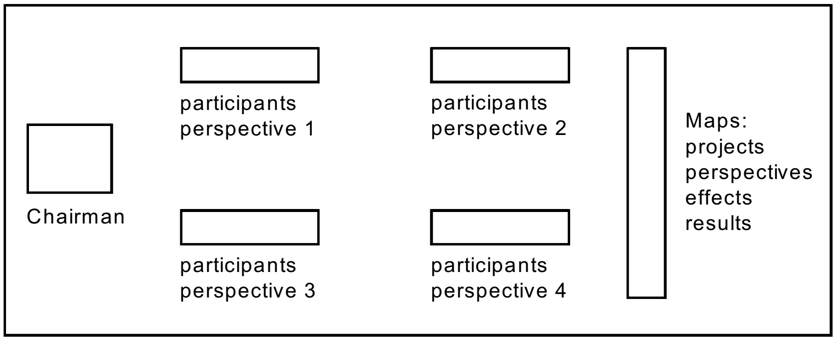

Figure 4.6 The "houses of parliament" scheme applied to the *"Het Nieuwe Ommeland"* debate

The participants were able to chose which perspective they would represent, on that way they formed the fractions in the debate. This organization prevented the 'chaos' which occurred in the previous debates and focused the discussion on perspectives and problems related to their realization and general policy choices. In contrast to previous debates, in this last debate participants were not asked to evaluate the method.

Analytic generalization of Proposition 2

The introduction of new elements into the HMD method has had partly positive and partly negative effects on the decision-making process. Therefore it is not possible to clearly confirm or reject Proposition 1. A summary of advantages and disadvantages of the new elements of the HMD method is shown in Table 4.2 on the next page.

4.3.7 Evaluation

In the following chapter we will present the findings about the quality of decisions and the improvement of the results of decision making that the HMD method intended to achieve. The results we present are based on the observations of preparations, direct participation in the decision-making process and the survey of participants in the "Debat der deelnemers". The broader report on these results can be found in the publication "Trug naar de basis; nieuwe wegen voor publieke besluitvorming?" (Tisma and de Vries, 1997).

On the basis of the theoretical background of this research we defined three criteria for the evaluation of the quality of the HMD method:
a. presence of a structure
b. influence of the participants on the process
c. public task.
These criteria are derived from the theories of pluri-centrism of Teisman and neo-republican citizenship of van Gunsteren.

a. Presence of a structure

Adequate decision making needs to be clearly structured, so that at every moment it is obvious when decisions are taken, who is taking them, on the basis of what criteria, and that there is clarity about interdependencies of the different phases or rounds in the decision making. Structuring is extremely important for the good progress of a decision-making process. According to Teisman (1998), decisions that are clearly and unequivocally expressed, that are fixed and have a

Element	Strengths	Weaknesses
Interviews	- Useful preparation for simulation - Informative about the subject of discussion	- Difficult to keep track of answers - Absence of interaction - Not seen as an integral part of the method
Simulation game	- Innovative in public decision making - Realistic, raises awareness	- Not enough insight into how to handle tension - No insight into mutual interdependencies
Debate	- Everybody can express his/her opinion	- Hybrid character - Unstructured
Multiple roles	- Insight into tension between personal and professional decisions	- Formulation of roles - Assignment of roles - Compilation of participants
Relationship between projects and perspectives	- Causally connecting spatial interventions of different scales - Showing connection between facts, wishes, and behavior	- Confrontation of perspectives and projects is not clear - Technically not well realized
Information about projects and perspectives	- A lot of useful information available	- Pre-programmed projects - Changing projects not possible - Information unreliable or difficult to access

Table 4.2 Overview of strengths and weaknesses of the new elements of the HMD method

clear status with as little ambiguity as possible, form a good basis for discussion about filling in the decisions. Only when we know what we are talking about, and on what basis we are debating with each other, is progress possible. Structuring is related to the more or less 'a priori' design of the decision-making process. It can be analyzed in two ways: by considering the regulations of decision making or by asking involved participants about their experience of the structure. Both ways are used in this case. The sample questions here are:
Is a logical and unambiguous sequence of different rounds and decision moments clearly visible in the structure?
Does clarity exist about the nature and status of the decisions already taken or still to be taken?
Does the structure provide distinct moments for joining and leaving the process and is the manner to articulate interest clearly defined?
Does the structure provide distinct moments when different rounds in the decision-making process are completed?

Results of analyses

The starting point for the evaluation of the structure of the HMD method was that clear, unambiguous structuring of the process is essential for adequate decision making. This is because under-structuring or over-structuring both lead to unsatisfactory results. If an insufficient imbedding is preset in the structure of the formal decision-making process, it leads to an unsatisfactory result. On the other hand, if the structure is too rigid, it can lead to resistance and conflict.

Quantitative analysis of the responses of the participants in the HMD debate "Debat der Deelnemers" shows that just a slight majority is moderately positive about the structure of the HMD method and the simulation game. As reasons for such an opinion participants cite the complexity of the written interviews, the ambiguous rules of the simulation game and the absence of a strong central leadership. As positive elements of the structure participants named the consequent succession of written interviews which properly prepared them for the simulation game; plenty of information about the strategies and projects available; and the very broad possibility for interaction and debate between them during the simulation game (before or afterwards it was not possible). Taking into account the opinions of the participants and our own observations and experiences, we can conclude that the structuring of the HMD method in this debate was not successful enough.

One of the questions in the survey of participants we conducted was whether they saw the HMD method as an improvement in comparison to the existing regulations of decision making in spatial planning. The answers were twofold. As a positive side of the HMD method, participants stated that compared to regular procedures it gives them more opportunities to express their wishes and priorities. This raises the quality of the content of the debate. But many participants indicated that at the same time this shows the weakness of the method: by giving the subject of the debate the central position, it becomes unclear how, when and on what basis crucial decisions are taken. This imbalance arises, in our opinion, from one of the basic assumptions of the method: that debate between conscious citizens must occupy the central place in political-governmental decision making, and that the results of the debate must be expressed in the decisions taken. Unfortunately, the HMD debate "Debat der Deelnemers" did not succeed in formulating a structure that would capture the opinions of participants and articulate them in a concrete and satisfactory decision. This was, however, greatly improved during the closing debate "Het Nieuwe Ommeland" on 2 October 1998.

b. Influence of participants on the decision-making process

Within a defined structure attention is focused more on the manner in which participants influence the process and interact with each other. This is because a certain structuring of the decision making has an influence on the course of the processes but it does not determine them. For instance, an instrument such as 'open plan forming' can, in a formal sense, provide the space for the introduction of a large number of diverse opinions and interests. But this structure will not ensure that the actors who possess the essential means (such as information or finances) do not dominate the end decision.

The essential question here is to what extent actors, whoever they are, within a given structure and on the basis of previously taken decisions, can have a valuable input in the (subsequent) process of decision making. Teisman (1997) names these criteria as (the possibility) of enhancement of the process. Enhancement occurs when (1) clarity exists about the previously taken decision and (2) when different actors are able (on the basis of previously taken decisions) to recognize their visions and interests in the continuation of the process. The illustrative questions here are:
How do participants experience the decision-making process and their own input in it?
Do they have the impression that their input is respected and incorporated into the final decision?
Are they generally satisfied with the results of the decision-making process?

Results of analysis

Looking at the process criterion in terms of the quality of the debate's content (which is the spatial development of the Netherlands) most of the participants interviewed were undoubtedly positive about the HMD method.

The reasons were that in the final strategies, participants could to a large extent recognize their input during the simulation. The debate and negotiations between different groups during the simulation game was very positively experienced. On the other hand, some aspects of the process were negatively felt. Some of the respondents had the feeling that during the debate people were not listening to each other enough, that there was not enough coordination in the discussion so a 'say whatever' atmosphere arose. The debate and simulation game required a high level of knowledge about the content and process structuring skills, which were not characteristics common to all the participants. Therefore those who were familiar with the matter had a dominant position in the debate, and this lowered the number of active participants in the debate.

The strength of the HMD method undoubtedly lies in giving the debate the central and most important position in the decision-making process. PUBLIC debate is again placed at the core of PUBLIC decision making. Participants had very positive experiences with this. Being able to think and decide jointly about the future spatial development of the country is therefore an important part of the HMD method. But the poor structuring of the method led to frustrations about the process. Thus the high potency of enrichment of the decision-making process, which was established in a climate of open discussion, is not fully realized.

c. Balancing diverse interests: the public task criteria

This criterion consists of two sub-criteria. In the first instance, in public decision making there must be a possibility allowing the interests of all actors to be articulated. In addition, the situation has to be prevented from arising whereby the results of the process bring excessive harm to other interests, opinions and priorities. According to van Gunsteren (1994), not all conceivable variety is good. Providing the possibility for generating alternatives, but also taking care that certain too-risky and too-extreme alternatives do not become dominant, is an important task of the government. Concrete questions about a public task are:
How far and at what moments in the process can actors show their interest and their vision?
Is the process structured so that the articulation of interests is stimulated or, on the contrary, prevented?
To what extent does each actor function as a protector of the generation of variation?

Results of analysis

In the ideal type of democratic state the interests and opinions of everyone who expresses them are weighed up in the final decision making. For this purpose various civil representative organs exist. The public task of the authorities consists of careful weighing up different interests, and equally the interests of groups that cannot represent themselves so well.

Many of the problems in current decision making come from a lack of protection of public tasks. Citizens are not sufficiently and timely informed, their complaints are not taken seriously, and alternative solutions are rejected a priori. This autism of the authorities threatens the quality of decisions, lowers their legitimacy and causes a delay in decision making.

The HMD method is one of the attempts to break this autism: ask the citizens what they want, direct and shape their wishes in a certain number of alternatives about which these same citizens would decide.

The participants interviewed felt this aspect of the HMD method to be very positive: the method suggests bringing social debate to where it belongs – to citizens. But in practice, various HMD debates ended with the decisions that were one-sided: investment decisions were to the largest extent directed towards 'one's own' housing environment at the expense of infrastructure development projects. This can be explained by the way that the HMD method looks at modern citizenship and public decision making. Theoretically the point of the HMD method is the assumption that when citizens are provided with complete information, when they know the rules of the decision-making procedure, they can jointly come to balanced solutions. But the practice shows that despite the fact that the modern citizen would satisfy the conditions of neo-republican citizenship, still some infrastructure is needed for the establishment of public cooperation with other co-citizens. When this is not the case, the consequences can be serious. In the case of MD simulation the result of the public decision making was a new map of the Netherlands which was filled with investments in housing (and nature) while infrastructure was left to 'someone else'. The method did not make participants aware that such division of spatial investments would soon lead to economic decay, because the HMD method has no 'mechanism' which would provide a counterbalance to the spatial consequences of unbalanced decisions.

4.3.8 Conclusions about the HMD method

The HMD Foundation has developed interactive simulation as a decision-making method. This method is complementary to existing decision-making procedures, such as PKB. HMD introduces three main innovations that should help decision makers to decide more quickly and more competently. These are: (1) emphasizing the difference between the projects and perspectives; (2) giving each participant in the decision-making process the roles of inhabitant, citizen and actor; and (3) structuring the decision-making process in three phases.

The major strength of the HMD method is that it is indeed an open planning process: it brings the public debate back to where it belongs - to the core of public decision making. Although there are some initiatives from the government side, this is not yet the case with official decision-making procedures.

In the HMD method the decision-making procedure is shorter and more efficient than regularly used procedures for adopting large-scale spatial plans. Nevertheless, the legal juridical aspect of the HMD method is completely undeveloped.

The connection between perspectives, projects and strategies is simulated in the proper way and broadens the insight of the actors into their spatial actions.

The HMD method teaches participants in a suitable manner about their multiple roles in society, and the tensions which originate from the confrontation of personal and professional interests.

The HMD method gives all the participants sufficient opportunity to express their opinion during the decision-making process.

The biggest limitation of the HMD method is the lack of structure, which decreases the quality of the process and the public task. The method lacks a mechanism to provide balanced decisions as a result of the process. In this respect, the last debate, *"Hat Nieuwe Ommeland"*, constituted a major step forward.

The HMD method is still under development and needs to be refined in many points in order to become competitive with the decision-making methods currently used. At this stage of development the HMD method can be considered as a complement to officially used procedures. In that sense it can be used as a means of assistance in bringing together a large number of actors in a situation where they can learn to understand better the relation between strategies and projects, the tension between individual preferences and professional priorities, and the logic of balancing processes.

In its policy document from 1998, the Foundation itself named several points of improvement that were to take place in the period 1999-2000. These are:

- better systematization of perspectives
- visualization of projects
- generation of innovative projects
- search for a proper method for impact analysis
- organization of additional debates
- writing a handbook of interactive decision making
- improvement of the *"Sprekend Nederland"* computer program

Yet in a letter of 20 August 1999 for a meeting of the management team of the HMD Foundation, Frieling reported that none of these points had improved. Despite the situation, the HMD Foundation still exists and is making new attempts to implement the method in spatial planning practice.

4.3.9 SUB-unit of the case study: the implementation of DSS in HMD

A very important aspect of the HMD case study for this research is that the method included a computer-based information and decision support system as its essential part.

During the three-year experiment with the HMD-method, two decision support systems were developed, both to be implemented in the second, negotiating, phase of the process (Figure 4.1). In the following section we will describe the construction, working, and integration of the DSS in the decision-making process.

We will also present some conclusions and discuss the value of this part of the case study for the development of our own system.

Description of the Sprekend Nederland DSS

The first DSS, called "Sprekend Nederland", was developed in cooperation with the Land Water Information Technology foundation (LWI)[11]. The system was a joint

[11] LWI is a Dutch foundation established in 1994 as a result of the initiative of the Ministry of Economic Affairs and the

project between several organizations: Cap Gemini, DHV, the Municipality of Rotterdam, Haskoning, IVM, Logisterion, Resource Analysis and Waterloopkundig Laboratory. The cooperation between the HMD and LWI foundations was implemented in two phases, through many meetings and several workshops.

The first phase, from September to November 1996, was devoted to working out the requirements for the tool and development of the conceptual model on the basis of the HMD method (Figure 4.7).

The second phase was devoted to building, testing and implementing the tool, and it was completed in June 1997. The tool, called 'Sprekend Nederland', was defined by developers as an 'instrument' for participatory decision making, applied to spatial planning, and based on the approach of the HMD method. The system was aimed at supporting the professional circle of the HMD debate, but the final ambition was for it to evolve into an Internet-based system to be used by non-professional citizens.

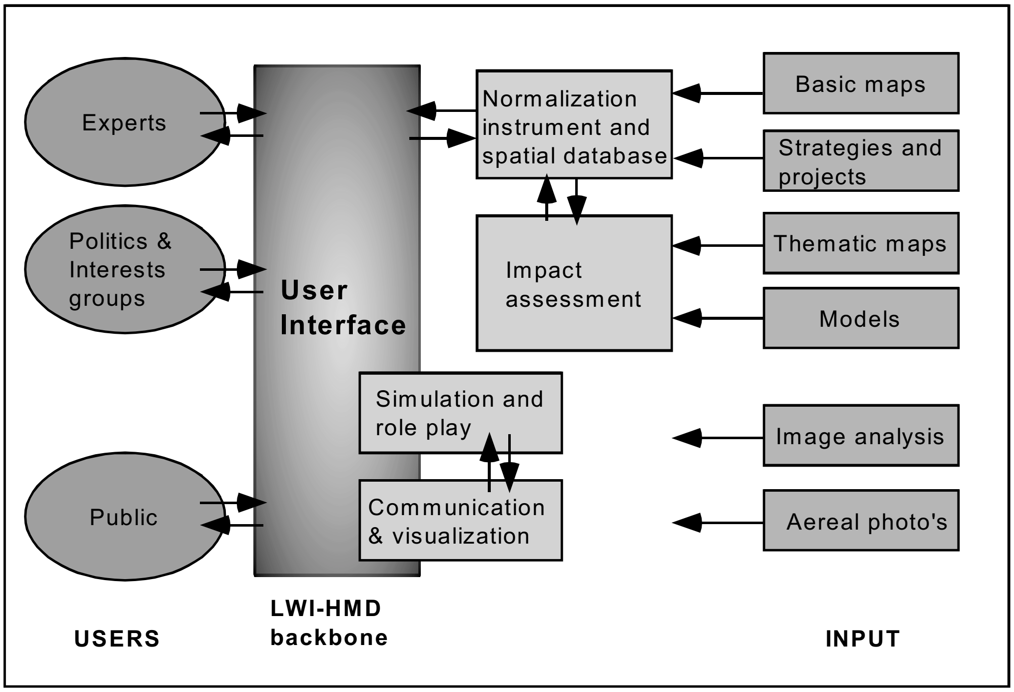

Figure 4.7 Conceptual model of the Sprekend Nederland 'instrument' (according to Rijsberman, 1996)

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ministry of Science and Education. Participants in the foundation are the Ministry of Transport, Public works and Water Management, engineering consultants, information technology companies, research institutes, universities and other companies. The objective of LWI is "the development of insight and instruments through the combination of knowledge and skills in the broad working domains of civil engineering, the environment and information technology, aimed towards the sustainable development and management of infrastructure" (quote from http://www.lwi.nl).

The practical construction of Sprekend Nederland in the first phase of development followed the exploration phase of the HMD method and it consisted of:

1 inventarization of existing spatial plans
2 analysis of spatial plans
3 normalization[12] of the plans in a specific way, so that they become comparable and allow development of new s trategies. All this together was called the 'normalization instrument' (see Figures 4.8 and 4.9) and provided the input data for the database of the system.

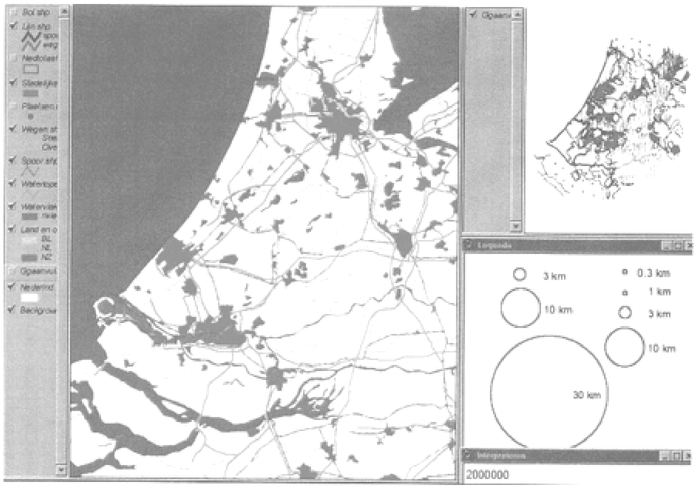

Figure 4.8 Normalization instrument: original plan and the legend used for interpretation

Figure 4.9 Result of the 'normalization' process – interpreted plan

[12] The term 'normalization' was used to describe the process of interpretation of existing plans to the same legend ategories. The underlying method is developed by de Jong basically in 1996 but also originates form his earlier work.

As a result the second phase had the complete Sprekend Nederland system. It consisted of three elements:

- A role-play subdivision, which simulates decision making about the spatial development of the Netherlands in the period from 2005 to 2025; the role-play game is structured and supported by the computer program that facilitates communication between the players;
- An integral impact analysis and normalization instrument, completely imbedded in GIS. The instrument was meant to enable comparison of effects of different strategies on the development of the Netherlands at the national level, as well as the visualization of these developments on maps.
- Two prototypes of the 3D visualization of the spatial transformation of the Netherlands: 'fly-over' by means of the 'Geokiosk' application, and 3D visualization of the landscape by using an application that joins GIS data with a virtual reality device.

From a functional point of view, Sprekend Nederland aimed to provide participants with information about strategies and projects. The information was pre-prepared and filtered by experts, in order to save time for decision-makers. Sprekend Nederland also had facilities for communication and negotiation between participants. According to the developers, 'for the participants the system should not be a computer game', it should give them the impression of a real decision-making situation, but one that is (through the use of a computer) better structured and forces participants to act in an ordered and organized manner.

Experiences with the use of Sprekend Nederland

The system was tested several times in proofing sessions before the first official implementation, which occurred on 6 June 1997 together with the first use of the HMD method for the "Debat der Deelnemers" (Picture 4.1 on the next page).

Unfortunately on 6 June the network-communication part of the system failed during the second half of the day so that communication between participants went back to traditional 'letters'. Having learned from experiences during the testing phase, the organizers of the simulation were prepared for such an 'emergency' situation so the simulation could continue with a slight delay. The system developers explained this failure with the shortage of time available for its development, and the changes in input information, which went on until the last moment.

It is very difficult to evaluate the impact of the system on the simulation game because of the failure of the network, but the general impression was that if it had worked it would have easily been integrated into the game and accepted by the majority of participants. At least, so it seemed in the morning session of the simulation. Nevertheless, some shortcomings of the system were noticed even in that short time of its use.

The system was not transparent enough and the user interfaces were sometimes unclear; these were the less important disadvantages. The most important shortcoming of Sprekend Nederland was the absence of a good working module for impact analysis. The ambition of the developers was to bring the specific knowledge of the experts into system by quantifying the impacts of water management, ecology, infrastructure, environment, social housing, transportation and so forth. The challenge was then to process this knowledge in a way that it is understandable to non-specialized actors in spatial decision making. Therefore the effects of changes in the use of space should be envisioned on a global level. According to LWI, 'not too detailed, because there is no time during the HMD simulation for studying large amounts of information. But as reliable as possible, as objectively as possible and readily understandable for the relative laymen in the aforementioned specializations'. Effects should be read from the maps, according to LWI, because that is the media that planners and urban designers use to communicate their plans.

But in the real system the large number of indicators of impacts (Figures 4.10 and 4.11 at the following pages) were all presented separately and participants would have to look at each of them separately and then make overall judgements by themselves. It was also not possible to measure the impact of a strategy or combination of the projects that resulted from the negotiation phase of the simulation.

Picture 4.1 The use of Sprekend Nederland during the 'Debat der Deelnemers'

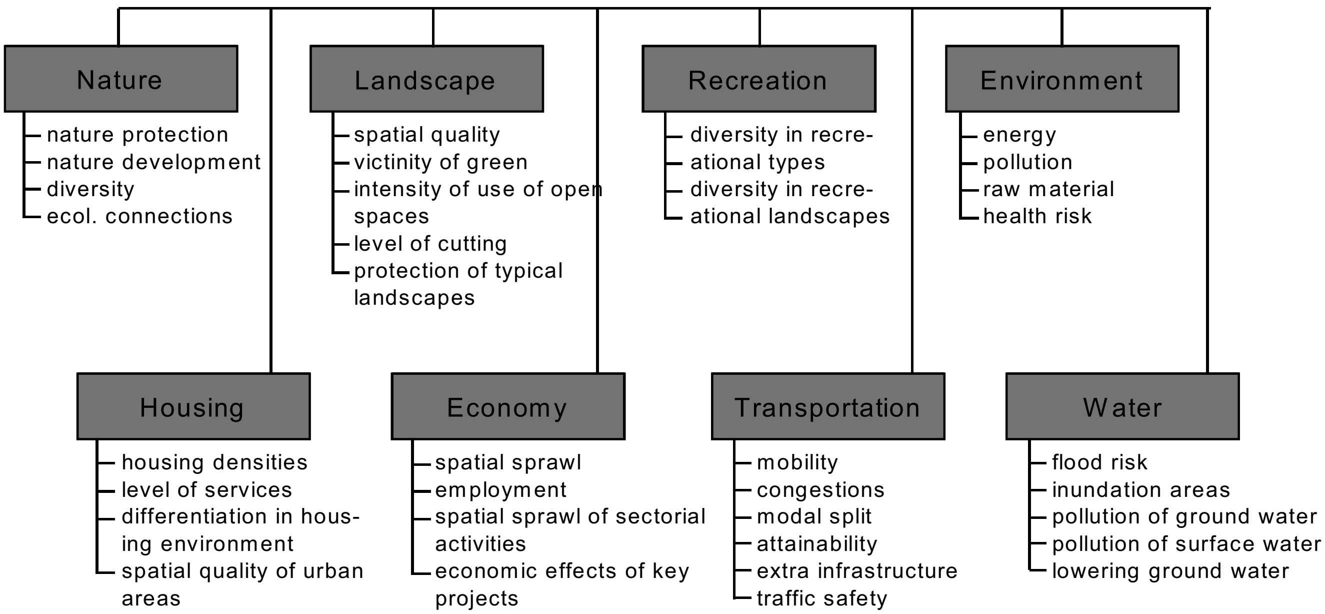

Figure 4.10 Content of the impact analysis tool with the major impacts and indicators that were used to quantify the impact

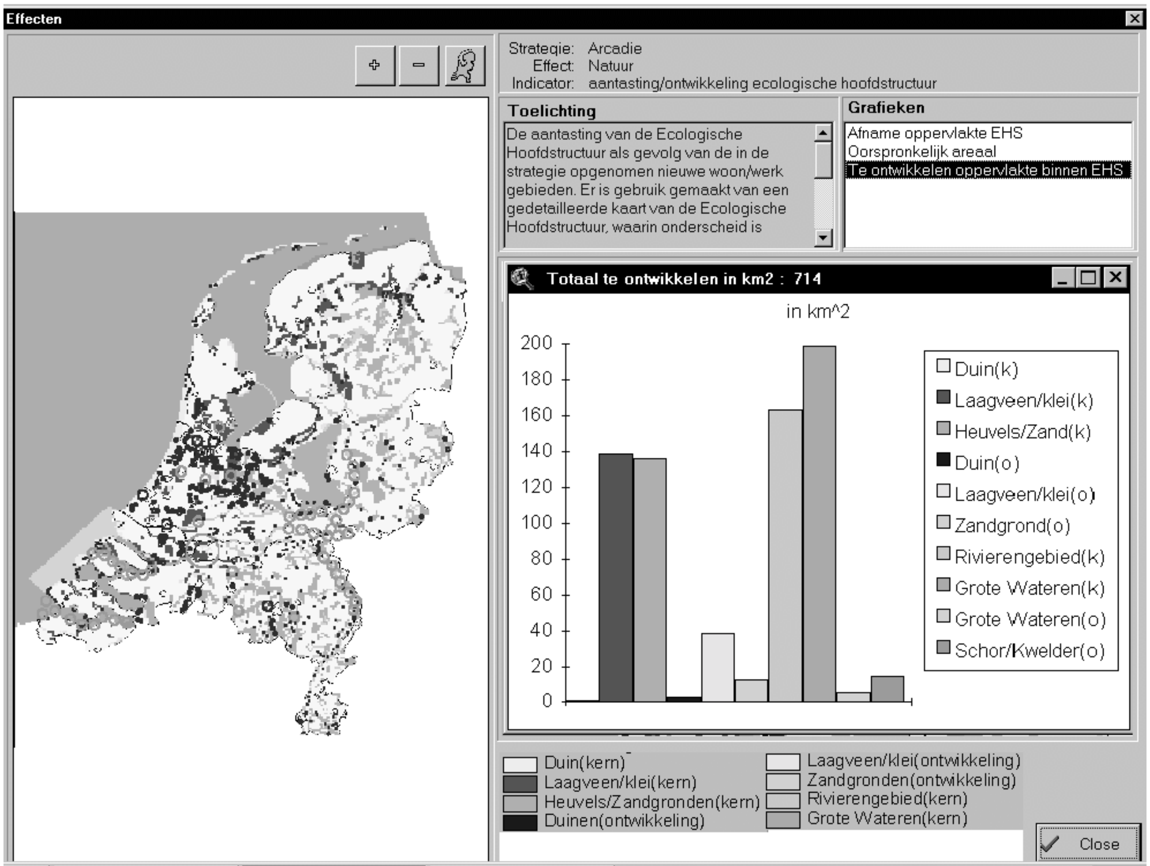

Figure 4.11 Interface of the impact analysis tool

It is unrealistic to expect that by using the system laymen can come to the right conclusion in a time limited to a few minutes. Sprekend Nederland should have connected individual impacts in a kind of multi-criteria analysis or similar technique, which was not the case. Therefore this part of the system was not used or not trusted by the participants in the simulation.

The difficulty of adding new information, transforming existing information and the problem of estimating the impacts of projects and strategies shows that the system architecture of "Sprekend Nederland" appeared to be too complex, user unfriendly and rather rigid. On the other hand the possibility to follow the 'status' of the investments and voting during the simulation shows that the system also had some parts that were able to capture the dynamics of the negotiating process.

The system involved different software components, such as GIS, spreadsheets and 2D and 3D visualization techniques. As there was no one expert organization to develop the whole system, LWI hired several partners, who developed parts of the system to be finally integrated through the user interface designed by the company Resource Analysis. The complexity of the system itself as well as the multifaceted organization involved in its development finally led to the product that failed on its first important test. Later LWI continued with to improve the system, basically making it simpler and implementing it in more specialized topics, such as water management.

After the event in the New Metropolis, HMD and LWI tried to adjust the system but with no success, and after some time cooperation came to an end. HMD hired the company Waterproof to develop a new system. In the following debates organized by HMD this system was successfully.

Sprekend Nederland second version: Waterproof DSS

The new system was focused on the proper and fast display of information. The use of the system for communication between the participants was abandoned and communication and negotiations occurred in the room, person-to-person. The system was, however, used to record transactions which resulted from negotiation between the participants. As the picture 4.2 shows the system was intensively used during the debates.

Picture 4.2 The second version of 'Sprekend Nederland' DSS was intensively used during the *"Windstreek"* debate

Successful performance of the system was achieved through the simple interface and clear structure that strictly followed the rules of the game. The representation was mostly textual and numeric while complex additions for visualizations were removed from the system. The system suited each individual participant by quickly providing an overview of personal portfolios with all the actions taken in the game; actions that were taken by other participants; and internal effects of decisions in the form of impacts on social and spatial problems. All the decisions that participants took in the role of inhabitants (settlement choice), citizens (strategy choice) and actors (project choice) were registered, processed, saved and publicly displayed. In this way the system was used very intensively on both the individual and collective level.

The second DSS served the purpose of the background tool, although not perfectly. In some situations the coupling between the simulation game and the system was poor and caused confusion between users. This can be explained by the organizers' lack of experience in the use of DSSs, and tended to improve through the learning process in experimenting with the HMD debates.

As was already mentioned, HMD intended to use a DSS in the second, negotiation phase of the HMD process. In the last of the HMD projects, a debate about the future of rural areas in the Netherlands (Het Nieuwe Ommeland), HMD made a first move towards involvement of information technology in the first phase of the process, by putting the questionnaires of the first phase (personal positioning) on the Internet. The questionnaires were sent to the debate participants by post, as in the previous cases, but in addition they were put on the web. As the debate was advertised in a few specialized agricultural magazines, persons other than those invited could also join the debate . The answers were processed and the users could soon see the results of the statistics for the whole participating community. The response to the website was shown to be quite good, as about 150 people visited the site during the debate, completing the questionnaires directly on the web site. Although the intention of the HMD foundation was to continue with the development of the Internet-based system, so far this has not happened.

4.3.10 Conclusions on the DSS

The use of a DSS within the HMD method underwent a certain evolution during the three years. In the very beginning the HMD foundation started with great ambitions and to that end cooperation with the LWI offered enormous expertise in different areas of specialization as well as technical support with the latest technologies. Yet the decision support system failed to satisfy the needs of users and there were several reasons for that.

At the time when the development of Sprekend Nederland started, the HMD foundation was still in the process of elaborating the HMD method. The method had not been tested before the computer system was added to it. Therefore the development of the method and the system went in parallel, which could have had a lot of advantages but in this case led to more disadvantages.

The HMD foundation developed the method for decision-making, but had no experience in the development of computer applications. Therefore it was a problem for the HMD organizers (most of them not computer users at all) to understand the computer logic which, if wrongly used, often causes rigidness in DSS systems. Therefore they could not foresee the difficulties that the LWI developers would have with the frequently changing ideas or input information the HMD developers wanted to bring into the system. To create a successful application in this case the system architecture had to be much more open and interactive than the concept LWI had chosen.

Most of the parties involved in the project on the LWI’s side had expertise and experience in the development of particular computer applications, but not with integral and complex decision support systems. A fascination with the possibilities offered by the new technologies they had in their hands made them too ambitious, without realizing how skillful one has to be in order to integrate them in a simple, user-friendly and functioning system.

In a sense, for both HMD and the LWI, this was the first experience in the practical development of a method and a DSS to support the method. Objectively speaking, the time the LWI had for the system development was too short, bearing in mind the complexity and requirements of the system. And because of its technical imperfection and low integration into the decision-making process, the Sprekend Nederland DSS had no effects on the final decisions of the 'Debat der Deelnemers.

Neither the LWI nor Waterproof could find the proper balance between making the system too complicated (which caused rejection by users) and making it too simple (which aroused doubt in the system).

The Waterproof DSS contained too much information, and although it was much better structured and worked fairly quickly (at the expense of proper visualizations), it led to information overload. Some simplifications caused participants to doubt the precision and reliability of information. Due to these (over) simplifications the value of its representation of reality was called into question. From the very beginning, the intention of the developers of the HMD method was to use the DSS only in the background, as a technical tool to support the communication between participants and information retrieval. On the other hand, Sprekend Nederland had much higher ambitions and at one point could have become a self-sufficient system. Neither the participants in HMD debates nor the HMD leaders were ready for this step. In the simulation game this led to confusion about the position and value of the system.

The succession of exercises with Sprekend Nederland and later with the Waterproof DSS made this point much clearer, and by the last of the 'Windstreek' debates the use of the system was somewhat efficient and successful. According to Teisman (1997), "The leadership of the simulation game had learned to play better their role of 'interface' between the system and the participants in the simulation". In other words, organizational restructuring was needed to make the DSS work. In this way the computer system became more and more supportive for the role-play and therefore better embedded in the method. During the simulation, participants in the debates where the Waterproof DSS was used fully relied on the information provided by the system. In that sense we can conclude that the final decisions of the participants were certainly influenced by the DSS.

Looking at the process of the Sprekend Nederland development, the old adage can be repeated again: no technology or expertise can develop a successful system if there is no strong concept behind it. This is partly to do with an unsystematic and 'ad hoc' approach and the shortcomings in the structure of the HMD method, and it is also to do with the inability of the developers of the HMD method to accept information technology as an integral part of the method. Were that not to have been the case a lot of confusion during the simulation game would have been avoided. As Teisman (1998) hopes: 'this problem will be partly solved by the coming generations of professional managers (and, we would add, citizens) who already grew up using information technology'.

The whole course of following the development and implementation of the DSS in the HMD method was an extremely valuable experience. The ambition of this research was from the beginning to develop a physical prototype of a complete DSS, something similar to what the LWI had in mind, but with much less expertise and financial support. As we followed the method and DSS development and adjustments, we could see the complexity of such a task. By analyzing the process of development and the system itself, we arrived at some preliminary requirements for the system to be developed in this research. These will be presented in section 4.7.

4.4 The case study of the Masterplan Zuidas, Amsterdam

Originally, the idea of this research was to use the Masterplan Zuidas as an example of a prototype of a tool for spatial decision support. The case was chosen because of its actuality and specific approach to plan development. More specifically, the Municipality of Amsterdam formed the Zuidas coalition in order to improve and speed up the decision-making process. The coalition consisted of the main landowners in the area and representatives of several city districts, and it worked together during the whole course of the plan development. But during this research the case of the Metropolitan Debate appeared as a more relevant one, and the case of the Masterplan Zuidas was given a less important position. Finally, it was used to gain an insight into the opinion of the citizens of the area about the Masterplan, the way information about the plan was presented, and about their participation in the decision-making process. This insight was later used for the design of the user interfaces of the Delta•M DSS.

4.4.1 Introduction to the Masterplan Zuidas

The Masterplan Zuidas officially began in 1994, when the Municipality of Amsterdam decided to develop an integral plan for an area of about 3 km in radius with the Zuid-WTC station as its center. The area is very close to Schiphol airport and the city center (Figure 4.12, on the next page). It is very accessible by car, train and local public transport, which was the reason why the Municipality of Amsterdam chose it for a top business location.

Looking at the urban structure of the area (Figure 4.13, on the next page), it was a sort of 'transitional zone' between two city parts – the south (*Zuid*), built according to the famous plan of the architect Berlage between 1920 and 1950, and Buitenveldert, a very well-known plan by van Eesteren, built in the 1950s and 1960s. The space between these two city parts was subject to several plans drawn up since Berlage's time, and which were partly implemented. This led to a situation whereby the green belt, which was formerly the edge of the city, was partly replaced with infrastructure, the south WTC station and several large office buildings

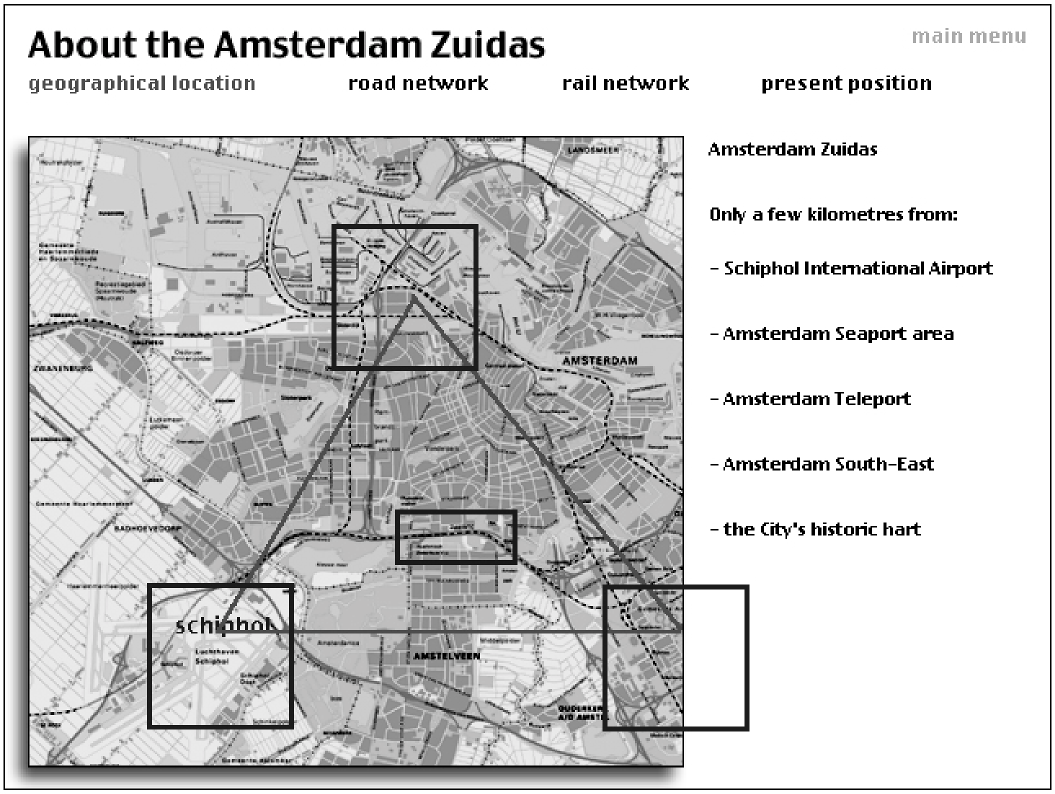

Figure 4.12 Position of the Zuidas in the region of Amsterdam (from the Masterplan Zuidas CD-Rom, Projectbureau Zuidas, 1998)

Figure 4.13 The map of 1:10000 of the Masterplan area

such as the World Trade Center, ING Bank, Atrium, and so forth.

Although totally different in form and style, both the Zuid and Buitenveldert districts have a lot of greenery. The main careers of the green infrastructure are two parks Beatrix and Amstelpark (with the strip that connects them, called 'Gijsbrecht van Amstelpark'), and the Amsterdam Forest.

After several transformations, Masterplan Zuidas was finally approved by the management of the Municipality in January 1998. The main architectural program of the plan is:

1. Extending the infrastructure and railway station to a international high speed train terminal;
2. Putting infrastructure underground (according to the DOK model);
3. Building 650,000m^2 floor-surface of offices, 1,500 new apartments and 6,500m^2 floor-surface of services

The design approach (see Figure 4.14 below) is to integrate two city parts and create a high-density urban area in between, where the functions of work, housing, greenery and services of all kinds mix to form a high quality environment.

Figure 4.14 The Masterplan Zuidas (from the documentation of the plan, 1999)

In the spatial planning regulations of the Netherlands a Masterplan is not a compulsory plan. It is a frame of reference for the spatial development of the area over a period of 20 years, designed by the municipal government. The Masterplan Zuidas is a strategy of phased development, rather then a final model. This approach allows for plans to be amended during the course of the project. To be realized, though, the Masterplan has to be translated into several local land use plans, which then become compulsory. At this moment several land use plans that are part of the Masterplan Zuidas are in the process of realization.

From the Masterplan Zuidas only the greenery aspect was explored in this case study, for two reasons:

- The time and the budget of this research did not allow us to examine the Masterplan in its whole complexity, and
- For the inhabitants of the area greenery is one of the most sensitive questions in the project. The new high-density built-up area in the Zuidas is to replace the green belt which still has a lot of sports playing areas. Replacing greenery with buildings is, in the eyes of citizens generally, and not only in this part of the Netherlands, an undesirable development.

4.4.2 The goals of the case study research

In June and July 1998 we conducted a survey of the inhabitants of the Zuidas area using written interviews. The goal of the survey was to learn:

- how inhabitants of the area experience greenery and landscape of their immediate and broader surroundings
- to what extent they use the green areas in the Zuidas
- what their opinion is about the changes in the landscape and open spaces that the Masterplan proposes,
- what their preferences are concerning the presentation of the plan material, and
- how they feel about participation in the process of decision making.

The outcomes of the survey were used for two kinds of analyses. First, where possible, questionnaires were statistically processed and then analyzed according to the themes defined in goals. Secondly, each questionnaire was analyzed separately and these analyses were used to develop the typology of user 'profiles' for the Delta•M decision support system (Tisma, 1999). The opinion of citizens about the means of plan presentation greatly influenced the design decisions on the user interfaces of the Delta•M DSS.

General information about the participants in the interview

The districts of Zuid and Buitenveldert are among the richest in Amsterdam. The population of about 300,000 people contains a high proportion of educated people or students, mostly of Dutch origin.

By the start of the development of the Masterplan, the citizens felt threatened by the planned densely built up area, and established several associations in order to protect their interest. At this moment there are 13 different associations and interest groups united under the name Citizens' Platform South Axis (*"Bewonersplatform Zuidas")*. The *"Bewonersplatform"* wants the 'ordinary citizen' in the future to also have the pleasure of living in the Zuidas. The platform mostly fights against high densities of buildings, trying to protect greenery, walkways and bicycle routes in the area from being cut and replaced by built-up elements.

4.4.3 Methodology

The questions for the survey were arranged on the basis of several other studies that were dealing with space cognition, the experience of the environment by users[13], and our own knowledge about the Masterplan and the decision-making processes around it.

In total 90 questionnaires were sent to randomly chosen addresses, half in the district of Amsterdam South and the other half in the Buitenveldert district. We received 25 questionnaires back and we conducted an oral interview with the chairperson of the Bewonersplatform Zuidas and her colleague. The survey questionnaires consisted of 34 questions divided into several themes. The questionnaires were statistically analyzed where possible and each of them was regarded as a separate case.

In the original plan we hoped to get a similar number of respondents from the respective city parts, but this was not the case. We received replies from 13 persons from Zuid, 6 persons from Buitenveldert and 6 did not indicate where they live. There were 13 men and 12 women.

Of the 25 respondents, 22 were older than 40 and only 3 were between the ages of 20 and 40. More than the half were working people (mostly high education qualifications) and the rest were retired (5), housewives (3) and disabled (2).

4.4.4 Results of the survey

Although we did not have a statistically significant sample of respondents, this research gave us a valuable insight into the opinions of the citizens of the area. The results we present here are therefore not explicit

[13] Hessels, Beleving en waardeering van groen, THD 1977; Tacken en de Kleijn, Beleving van woonsituaties, Stichting GSIOGO 1979; Wegen and van Voordt, Sociale veiligheid en gebouwde omgeving; theorie, empirie en instrumentontwikkeling, Publikatieburo Bouwkunde, 1991.

findings but more orientation, and are of importance for the design of the Delta•M DSS.

Greenery

At the beginning of the questionnaire the respondents were asked to mark on the map where they live and to draw a border of what they feel to be their neighborhood. Figure 4.15 shows how they reacted differently to this question.

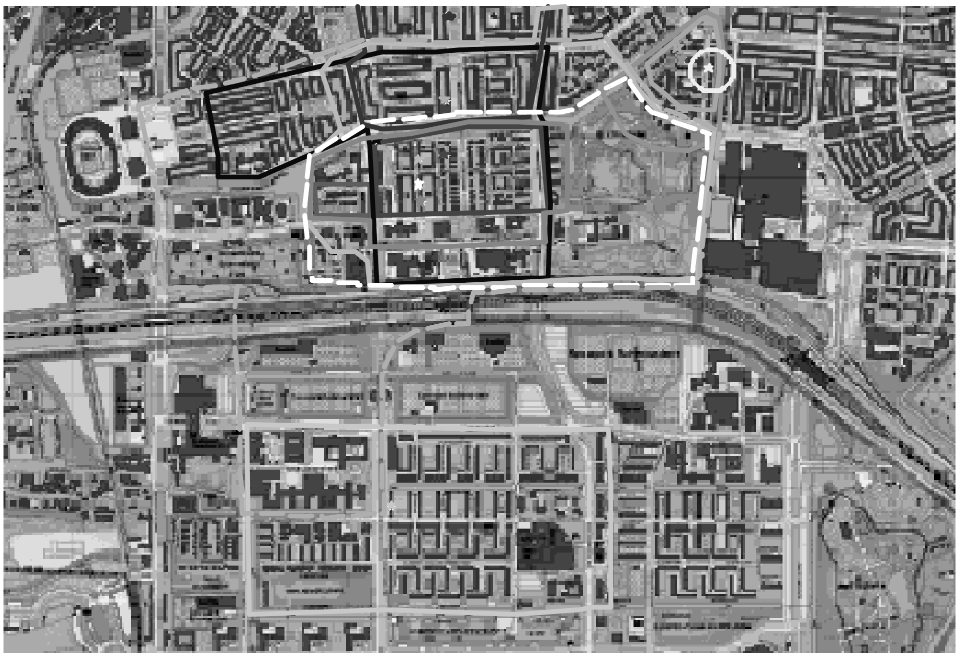

Figure 4.15 How different people experience the border of their neighbourhood

The ability of the majority of respondents to represent the 'cognitive map' of their neighborhood on the real map was limited, with very few exceptions.

Further on the respondents were asked what they thought about the amount of greenery in their neighborhood and the whole Zuidas area, then to mark the nicest and ugliest landscapes on the map, and what they would do to improve the ugly ones. Then questions were put about how often and in what way they use the green spaces.

The respondents were greatly concerned about the greenery, both in their immediate and broader surroundings. Although they think that there is enough greenery, they would prefer to keep it whenever it is possible, even if it is not particularly nice or useful. They would rather improve the green areas through revitalization and better maintenance than to replace them with built-up areas. The respondents very frequently use the greenery in the Zuidas area in various ways: for resting, walking, cycling, sport, play or simply for relaxation and enjoyment in landscape and greenery. The most popular places are Amstel and Beatrix parks and Amsterdam Forest. Very few people named any places as ugly.

Existing space of Masterplan

This part of the questionnaire explored the ways people experience and use the open spaces in the Zuidas area now, and how they react to the changes that are proposed by the Masterplan.

The questions here concerned the 'core' area of the Masterplan, Zuidplein, and the dike (*dijk*) with the heavy infrastructure dividing the two city districts. There was also a question about the use of the sports fields on the south side of the 'infrastructure bundle'.

It can be said that at the moment the core area of the Zuidas is used mostly as a transitional zone which people pass very frequently on their way to the north or south, very rarely staying there for reasons other than for waiting for a bus, tram or train. The exceptions are inhabitants of the Zuid district whose children often play on the pentangular playground between Princes Irenestraat and Strawinskylaan. Those people would not see the dike with infrastructure as a barrier but as protection from the 'threatening' office district. Zuidplein in its current state is experienced by most of the respondents as an unattractive, not particularly nice space with moderate quality. Generally speaking, the people interviewed did not feel greatly disturbed by the infrastructure bundle, with the exception of a few people who felt enclosed or unsafe, especially at night. The sport fields in the area do not seem to be used very much by this group of people, probably because of their age.

Opinion of the Masterplan

It is very difficult to draw some general conclusion about the opinion of the respondents concerning the

Masterplan. However it is possible to note that there are two extremes in this group of people - one extreme is very much against the plan and the other thinks of it positively. In between the two extremes is a small group of people who are indifferent or have neither a negative nor a positive opinion.

The aspects of the plan dealing with landscape and greenery were split into several elements and questions were put accordingly: the Dok model (which means to put all the infrastructure underground and free up the ground level for urban functions); 'Zuidelijke wandelweg' (a proposed green route through the whole area); and a new canal on the south edge of the plan area.

Looking at the plan elements, the Dok model got the most negative votes (mostly coming from inhabitants of the Zuid) while Zuidelijke wandelweg and the new canal were positively received.

By putting questions about the influence of the Masterplan on the local (neighborhood), city (Amsterdam) and regional (Randstad) level, we wanted to examine how people think in different spatial scales. It showed that their position was much more clear at the local level, while quite uncertain at the city and regional level. We can speculate that this is partly a consequence of the lack of information about the importance and integration of the Masterplan at the 'higher' levels. In the scale of city and region interpretations of the facts are global while recognizable details are disappearing. Therefore the local scale stays the most understandable and grounded to the users.

Means of plan presentation

The idea here was to examine citizens' preferences concerning the means of plan presentation – text versus images.

24 of the 25 people very carefully or at least partly read the brochures they get from the Project Bureau Zuidas about the Masterplan. None of the respondents said that she/he does not read them at all, and only one said that he only looks at the pictures. 19 of the 25 understand the language of the brochures very well, 4 people understand it moderately and only one very badly. Asked what they prefer, textual or visual material, 11 had a strong preference for visual, another 11 would like to have both textual and visual material and only 2 prefer text. The great majority of respondents think that they are very good in reading a map (17) while only two admit that they are very bad at this.

Among the respondents there were only 4 Internet users that use it every day and 6 that use it from time to time. One said that he plans to use it in the future.

Participation in the decision-making process

The questionnaire contained two questions about this subject: what do inhabitants feel about the authorities' respect for their opinion, and the value of their influence on decision making about the Masterplan.

The feeling which respondents have about their participation in the decision-making process is very negative. In the majority of cases they think that their opinion is not respected and they do not have any influence on the decision-making process.

Experience with oral interviews

We conducted an oral interview with two persons who were at that time representatives of the 'Association of inhabitants of Bethovenstraat/Parnassusweg'. Now they are joined together with other similar associations in the *"Bewonersplatform Zuidas"*.

The Association was established in the period when the World Trade Center was built in the area at the beginning of the 1980s, as a strong opposition to that project. The current expansion of the office area in Zuidas is, in the eyes of the Association, seen as one more threat to peace and privacy in their neighborhood. They are actually satisfied by the situation as it is now in the Zuid part of the city , which is a quiet housing area, socially safe and with lot of greenery. They are afraid that the new station will transform the area into a new Damrak[14], that the high office buildings with many employees will make the area crowded and congested and that greenery will disappear in the characterless, supermarket-like mass-use space. The two people interviewed had a high level of knowledge about the historical developments and spatial character of the Zuidas area. They are also intensive users of the greenery in the area.

The way the two persons reacted to our questionnaire was strongly backed up by their negative presumptions about the Masterplan and Local Land Use Plan for the core area in Zuidplein. They saw me as a supporter of the plan team and reacted to some questions in a biased way. After talking to them, I realized that there were many reasonable points in their reaction to the plan, but a lot of "parochial" thinking as well. It was important to note that they lacked sufficient information about the importance of the Masterplan on the city and regional levels, which would otherwise have probably made them think differently. On the other hand, their frustration about not being involved in the planning process is well-founded, as they know the spatial and functional character of the area very well and they are competent enough to take part in the designing and decision-making processes.

[14] The street that leads from the Central station of Amsterdam to the center of the city, a realm of prostitutes and junkies.

4.4.5 Concluding remarks concerning the development of the Delta•M DSS

Although the response to the interviews was below our expectations, we obtained sufficient material to learn a lot about the questions we put at the beginning of the inquiry. The important conclusions gained from this survey and later used for the development of the Delta•M DSS are:

- in order to help users to understand the broader context of the plan, information should be presented not only at the local, but also at the city and regional level with the same amount of data and details;
- visualization of information should be the way to present spatial plans whenever possible, but a textual explanation is of equal importance for many people
- Although the use of the Internet was very low in the group of citizens interviewed, we need to bear in mind that since that time the Internet has spread at an annual rate of 50%, and we see there an opportunity to improve citizens' bad feeling about their low influence on decision-making processes.

4.5 The case study of the 'Deltametropolis' web site

The case study of the web site of the Deltametropolis design studio was carried out in the period from March 1999 to November 2000. This case is about designing the web site and presenting information about graduate projects of students of the studio. The projects have also been used for the database of the prototype of the Delta•M DSS, which was built simultaneously to the web site development.

The web site of the Deltametropolis studio is one of six sites of the 'Architectural Intervention' (AI) project which was at that time running at the Faculty of Architecture in Delft. Therefore the content of the site had to fulfill some requirements that were posed to all the studios, such as: information about the participants, information about the projects the atelier is running,

the literature the atelier is using, data that can be commonly shared, and so forth. In the case of the Deltametropolis website the requirements of AI were extended with a new feature – in addition to the informational function, the website was assigned the function of 'design', which will be explained later.
In this text the website of the Deltametropolis atelier will be discussed in three capacities: as a source of information, as a means of presenting projects, and as a 'design tool'. We will then draw some conclusions relevant for the design of the Delta•M prototype.

4.5.1 The Deltametropolis site as a source of information

When a visitor enters the address of the Deltametropolis site into the browser (www.bk.tudelft.nl/ai/deltame-tropool/index.htm), sixteen flashing images arranged in a 4x4 table on the black background welcome him/her. This is the GATE of the Deltametropolis website. The flashing images are GIF animations consisting of 6 images:

- a part of the map of the Deltametropolis area,
- a map of the location of a student's project,
- the image of the building he/she designed,
- his/her photo,
- the name of the project and
- the student's name.

The animations are fast and almost unreadable and they are just an indication of what is behind. 13 of the animations are links to information about the projects of students, and the three at the upper left are links to streaming videos where the mentors of the studio, Prof. Ir. D.H. Frieling, Prof. Ir. C. Weeber and Dr.Ir. W. Reh explain their ideas about the research and the education aims of the Deltametropolis studio. Above the table with animations is the name of the atelier: Deltametropool, which is a link to a summary of the atelier's goals. Beneath the table is a row of links to other information about the people, projects, perspectives and tools.

The gate itself is not informative - it is meant to attract and interest visitors to go deeper into the website and learn more about the studio. Our experiences with presenting the site to various people show that this approach works - most of them liked the design of the gate and wanted to examine it further, although it takes time to load it with a slow computer and modem.
Figure 4.16 shows the map of the Deltametropolis site with the content of the pages and links between them.
Figure 4.17 (on the next page) shows how the Delta•M and Deltametropolis websites are linked.

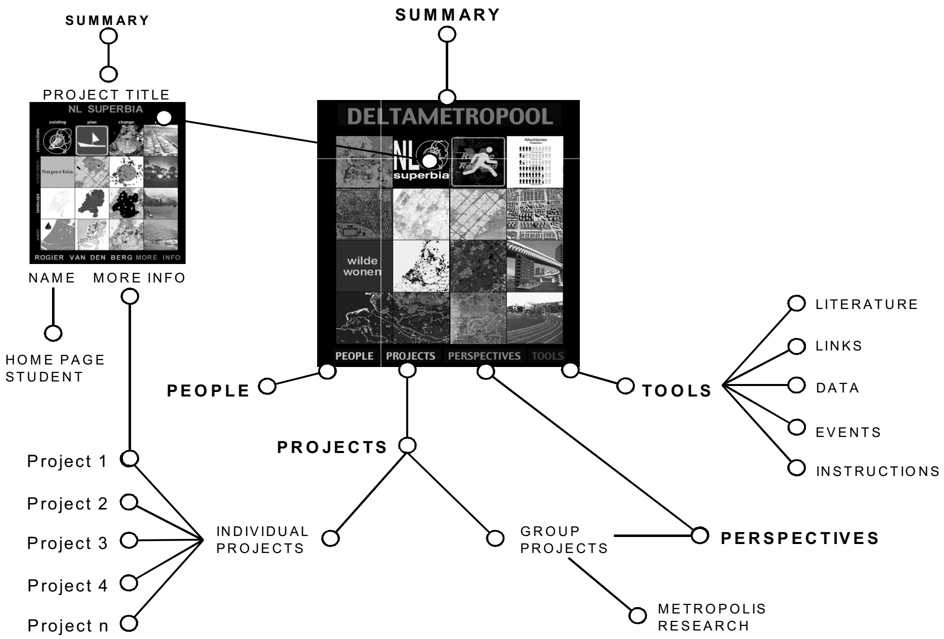

Figure 4.16 The map of the Deltametropolis web site at www.bk.tudelft.nl/ai/deltametropool/index.htm - information on the pages linked to the titles PEOPLE, PROJECTS, and PERSPECTIVES is located in the 'outside' world - information on the TOOLS pages is mostly intended for students of the atelier

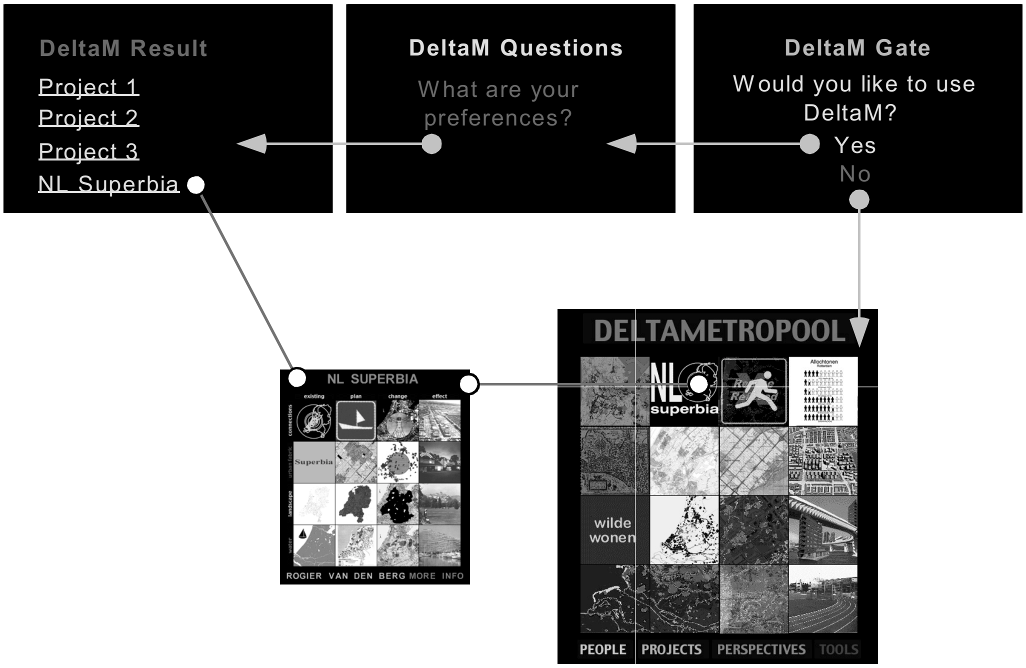

Figure 4.17 Link between the Delta•M site at www.bk.tudelft.nl/deltametropool/deltam.html and the Deltametropolis website - the projects from the Deltametropolis site are used for the database of the Delta•M DSS

4.5.2 The Deltametropolis approach to the presentation of architectural and urban projects

Within the design studio it is accepted that the name Deltametropolis stands not only for the area between the coast of the North Sea, North Sea channel, Nieuwe Waterweg/Oude Maas, and the 'Nieuwe Hollandse Waterline' but also represents the concept of the understanding of physical space. In that concept Deltametropolis is assumed to be a synergy between four systems: urban, connections, landscape, and water. This assumption was followed in the design of the 'matrix' used to present graduate projects of students of the atelier. The rows in the matrix describe the four systems - connections, urban, landscape and water. The columns in the matrix carry information about the time dimension and the consequences of the proposed spatial interventions. They show the existing situation in this place and in this system at the moment the intervention occurs; what a student is proposing/ planning in the future; what is going to change as a result of this plan; and what the effect will be of the proposed change on that system.

The information about projects is in the first instance and predominantly of a visual type. Textual information follows, but it is presented in the second layer. In the design of the site a strict hierarchy in the amount of information presented at any one time is also used. A visitor is at first glance offered only a set of sixteen images. Behind each of them, revealed by just dragging the mouse over the images, a very short text appears. By clicking on an image, a bigger image and more text about the same topic appears in a new browser window. For those who want to know about the project in full detail the link 'more info' leads to the complete text about the project. The link behind the student's name is to his/her home page, and it is intended to offer further information about the student's work.

The amount of information is arranged in the above way because one should keep in mind the fact that the average visitor spends about 5 to 6 minutes on a website. We try to capture his attention and show as much as possible of a student project within this amount of time. But for those 'non-averages' we also offer the full information.

The 'matrix' page is available for students to show their work 'in progress'. As we partly automated the input of matrix images, students can gradually fill it, leaving empty the squares that they have not yet answered , or changing the images at a later stage in the project development. This is, however, a disadvantage for the Delta•M DSS, because users of the DSS cannot get complete information about all projects from the database.

4.5.3 The website as a design tool

The Deltametropolis site with the matrix that follows the main idea about the Deltametropolis as a system and tries to capture the dynamics of spatial change, can also be seen as a 'design tool'. It would appear simple and obvious that we have this 'matrix' in mind, but in real designing or deciding situations this is not the case at all. And in a studio, students are mostly occupied with their own design subject without really thinking about its link and relationships with the broader spatial context. They are usually engaged in only one or two systems, forgetting or neglecting the influence of the project on other spatial systems, which in reality are very much present. By employing the matrix in the presentation of projects we have tried to stimulate students to think about the Deltametropolis as a synergy of at least these four systems of the physical world.

4.5.4 Conclusions: Experiences gained from the 'Deltametropolis' case study

During one year of creating, changing and maintaining the Deltametropolis website we came to the following conclusions:

The matrix is one of the most important points of discussion concerning the design of the website. For some students it is difficult to fit their projects into this relatively rigid scheme. In most cases students begin to work on their graduation project with broad research on their subject . However, after a few months of sometimes more and sometimes less successful rambling they end up with a design of a building or a city part. It is then difficult for them to choose which of the two scales to present in the matrix, or how to combine both of them in a sensible 'story' represented by small images and a little text. The problem of converting images from large architectural drawings to small pixel images while successfully keeping enough information about the project is another difficult point. This needs to be further discussed, because there are several possibilities for solving this problem.

Preparing the complete material for the website is time-consuming, and submitting material for the website is not compulsory. For this reason the database of projects of the Delta•M system contains only a small number of projects and most of them are incompletely presented. Although we partly automated the input of images (with the device described in Chapter 5.4) most of the work relies on students who have to select proper images and texts to present their projects, and this work cannot be automated. The quality of the presentation material depends to a large extent on the abilities and motivation of each of the students. The material is therefore varied in quality, and in the case of Delta•M , where projects are judged on the basis of this material, bad presentation can be a reason for users to reject a project.

Despite all the problems and shortcomings in the quality of presentation of the projects, we still managed to get some material for the database. And this was an enormously valuable experience for the future development of both the Deltametropolis website and the Delta•M as a complete DSS.

4.6 Case study: "The Open Place – No man's land?"

This case study is about an Internet discussion which took place in the period between 8 February and 16 May 2000. The initiators of the discussion were the department of Urban Design of the Faculty of Architecture (TU Delft) and the HMD Association. The discussion was organized in cooperation with the Dutch broadcasting company VPRO.

At the initiative of the journalist Marjoke Roerda, who for years was involved in radio programs about spatial issues, in November 1999 VPRO started an Internet discussion about the spatial problems of the Green Heart. To date three more discussions have been organized with different subjects. The VPRO website at http://www.vpro.nl/programma/deopenplek includes a direct link to the radio programs of Marjoke Roerda and a database where information about the topics of the discussions are stored and can be retrieved and added to by participants. The website has four discussion forums where participants can answer questions and give their opinions, react to the opinions of other participants, and communicate with VPRO.

The purpose of this case study was to start a broad social discussion about a particular spatial problem in the Leiden region, which was given the name *"Niemands land?"* – No man's land. The discussion was set up as the fifteenth and final one in a series about the Green Heart. The experience gained in this case study was used for the development of the complete Delta•M DSS.

4.6.1 What is "Niemands land?"

"Niemands land?" is the name that we gave to the area of land between Leiden and Alphen aan den Rijn in the west-east direction, and between the river Oude Rijn and the N11 road in the north-south direction (Figure 4.18).

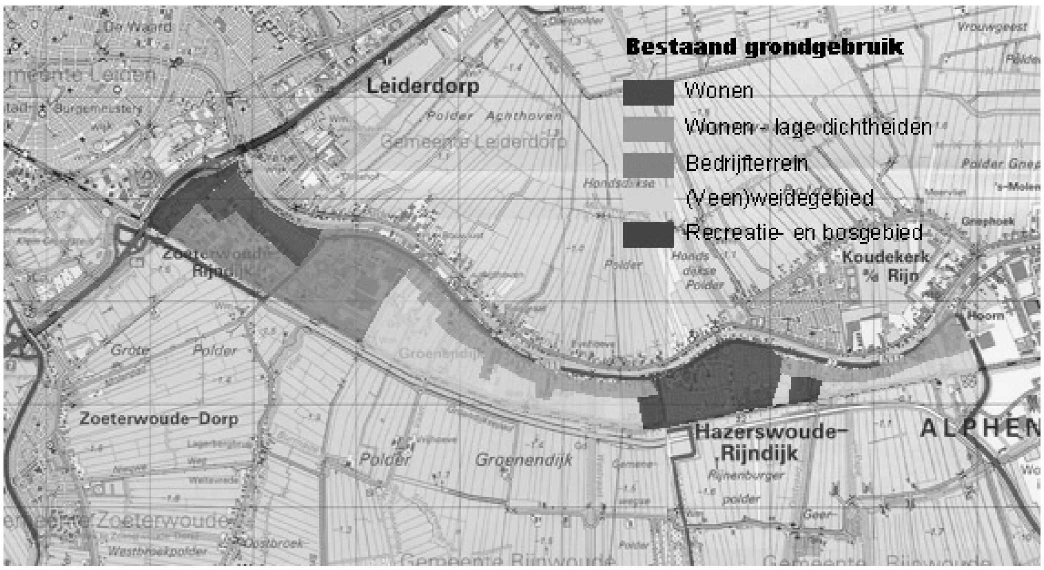

Figure 4.18 The geographical position and land use of "Niemands land"

This name was not given for no reason; rather it illustrates the spatial conflict which occurs in this territory. The conflict arises because of different views on the future spatial development of the area, which are the result of different planning documents that have been drawn up for this area over the last few years. These conflicts are presented in Figure 4.19 at the next page.

On the national scale, the HSL-zuid plan proposes to build a tunnel for high speed trains under the area of Niemands land, in order to preserve the natural and cultural values of the Green Heart. The tunnel will cost about 900 million guilders.

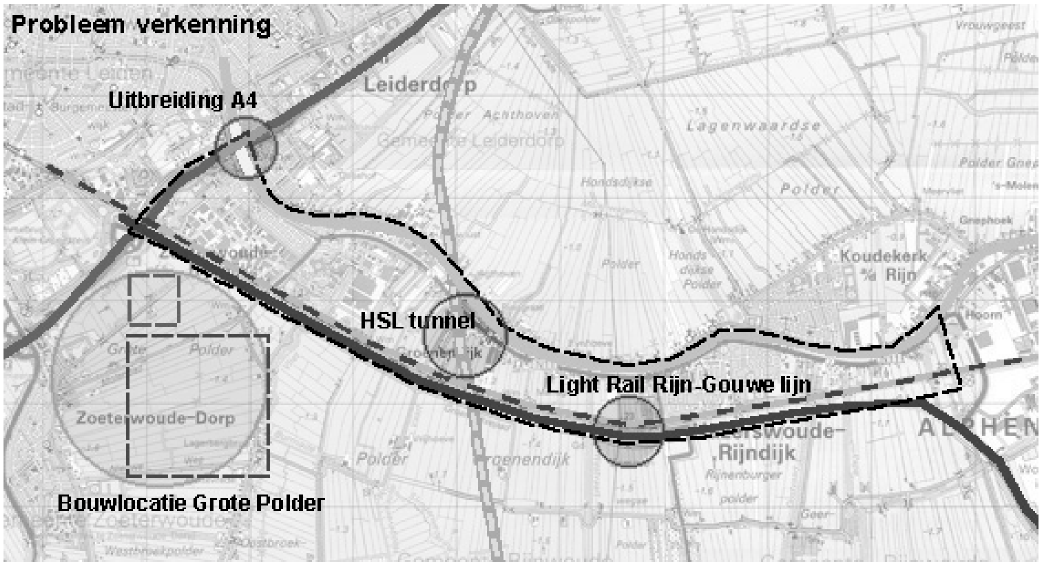

Figure 4.19 The spatial planning conflicts in the "Niemands land" area

At the same time, on the regional scale, several plans[15] were made with contradictory propositions. Some of them stimulate urbanization of the area by reinforcing infrastructure on the southern border of the area, like the Rijn-Gouwe lijn. According to that plan the railway network will be intensified or a new track will be added, and additional train stops will be made between Leiden and Alphen aan den Rijn (Figure 4.20, see at the next page). The Ministry of Traffic and Transportation is considering upgrading the N11 national road to an "A" highway and connecting it to the A12 highway. It is well known that if this happens, the urbanization of the area will be an unavoidable consequence.

On the other hand, the Groenblauwe slinger development plan (1999) emphasizes the natural value of the polders in the area and proposes a green corridor just in the middle of Niemands land. The corridor should serve as an ecological link between the areas on the south and north of Niemands land (Figure 4.21 at the next page).

In the two parts of the Regional plan (Streekplan Oost and Streekplan West) this concept is accepted. But there are zones indicated for further urbanization in the western part of Niemands land (Gemeente Zoetervoude) and in the Grote polder to the south of it (Figure 4.22 on the following page).

The most recent discussions which are relevant for the developments in Niemands land concern the decisions about the reconstruction and extension of the A4 highway, the solution for the storage of excess surface water and the possible construction of a multimodal transfer node at the crossing of the A4 and railway line to Utrecht.

Since 1999 the Rijnwoude municipality has been occupied with the development of the Local Land Use Plan which is supposed to find an adequate solution for the spatial development of part of the Niemands land area.

[15] 'Investeren in de toekomst van het Groene Hart' (1995); Streekplan Zuid-Holland Oost (1995); Streekplan Zuid-Holland West (1997); Discussienota 'Randzone Groene Hart (1999); Verkenning Rijn Gouwe Oost, planhorizon 2010 (1999); Ontwikkelingsperspectief Groenblauwe Slinger (1999); De driehoek in beeld (1999); Bestemmingsplan Tussen Rijn en Rijksweg (2000) This list is not exhaustive because there are some other less relevant plans which we have not mentioned because they are not very precise or are already obsolete.

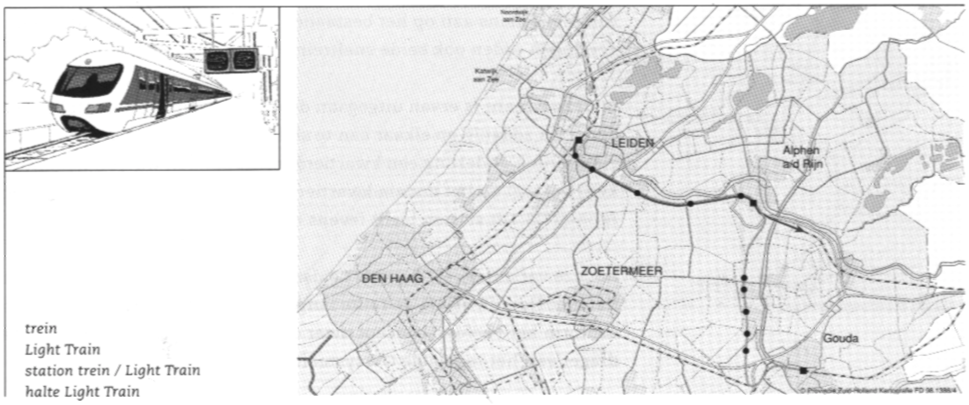

Figure 4.20 The variant for the Light Train from the plan Rijn-Gouwe Lijn

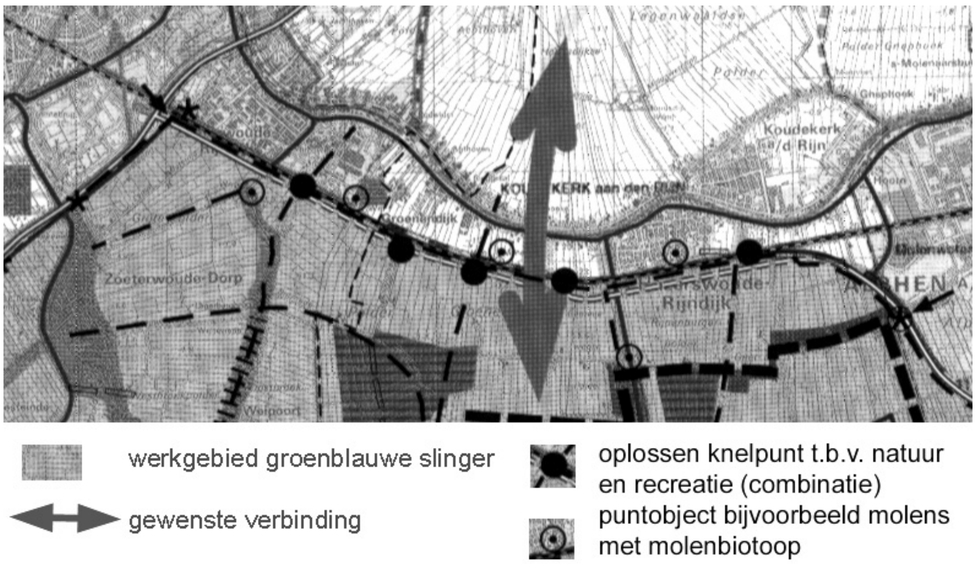

Figure 4.21 The Groenblauweslinger plan shows than an important ecological link should go through the middle of Niemands land

4.6.2 Case study propositions

Before we started the *"Niemands land?"* discussion, I had already followed several other Internet discussions about spatial planning issues[16]. The experience was that the participation of people in these discussions was generally very low, the number of participants decreased as time passed, and there was no real engagement or enthusiasm that would result in any kind of improvement of the decision-making process. In depth analyses have been conducted into the reasons for this problem (Zuiderent, 1997, Scheele, 1997, Jankowski et al., 1997, Doorn and Enthoven, 1997, Frissen, 1998,). The main reasons for the low participation, in my opinion, are that if there is no strong reason, if there is no clear goal statement, if people do

[16] To name a few: the Internet discussion on the Masterplan Zuidas, the Zwolle City Development and the VROM discussion on the Netherlands 2030.

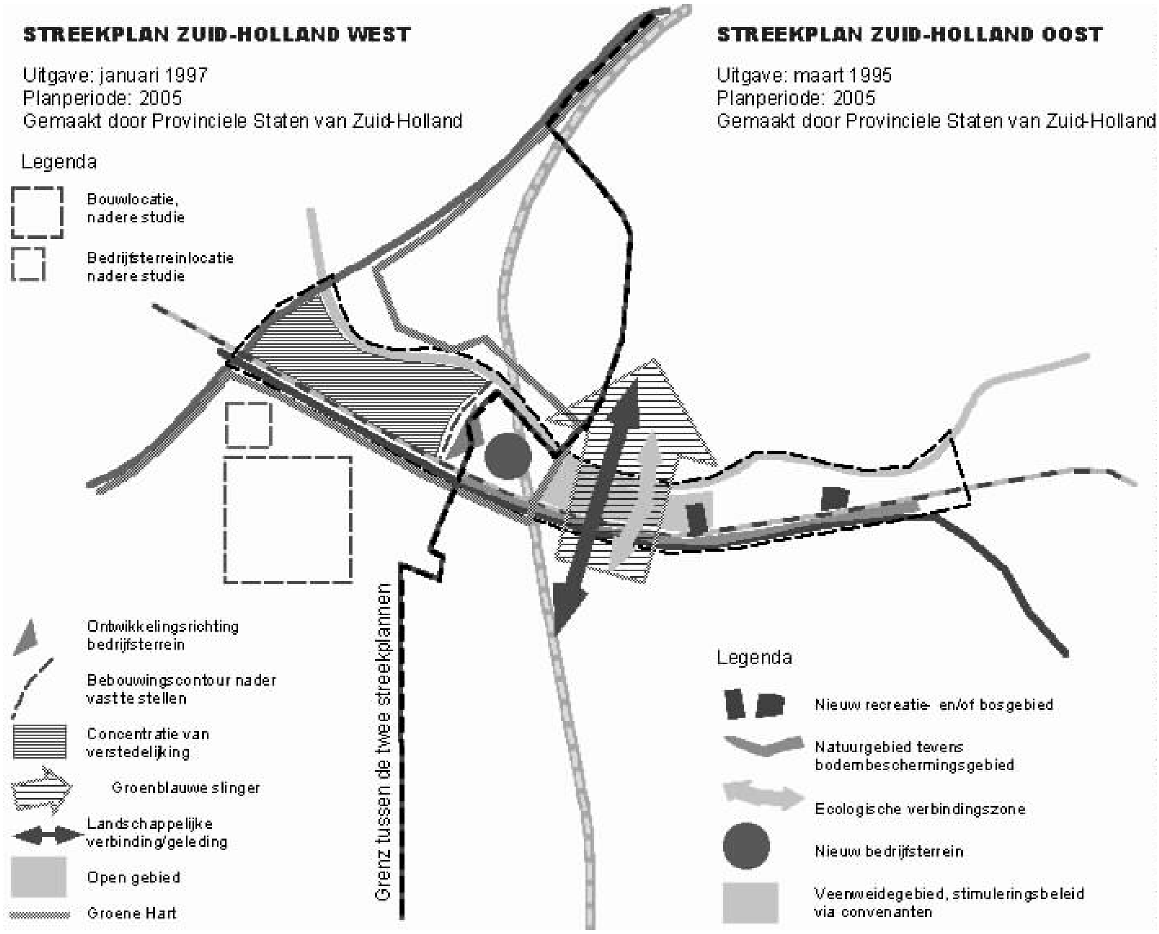

Figure 4.22 The South Holland west and east regional plan

not see how they can influence the end results of such a debate, they will not spend their time in a voluntary Internet discussion.

By organizing the *"Niemands land?"* debate we hoped to improve participation because we had more means at our disposal than Internet debates usually have: we had the VPRO broadcasting company which already had established an infrastructure connecting the Internet and the radio program, and we had the organizational support of the management bureau of the HMD Association. The idea was that we would improve participation and through that gain new knowledge because:

- The discussion would concern a concrete and actual spatial problem.
- The discussion would be structured in a question-answer form as was usually done in the first phase of decision making according to the HMD method.
- The HMD Association and TU Delft would permanently stimulate participants to take part by sending them letters and e-mails, and immediately reacting to any question or other kind of input from the participants.
- The VPRO website would host all the Internet communication with and among participants.
- VPRO's Radio 5 , which is connected to the website, would open the discussion, report the alternative solutions for the spatial arrangement of *"Niemands land?"*, and at the end of the discussion invite all the participants to evaluate the process in an open radio broadcast.

- During the whole course of the debate all information, radio programs, and forums for discussion would be permanently available through the VPRO website: http://www.vpro.nl/programma/deopenplek/index.shtml?2785571+3299944

4.6.3 Organization of the Internet discussion

The Internet discussion was planned in three steps. The first step was called: What do we know? It ran from 15 January to 15 February 2000. In this period about 1000 participants were invited to the discussion. In order to inform them about the subject of the discussion we arranged all the information on VPRO's Internet site. The start of the discussion was marked with the radio program[17] in which invited guests discussed the problem of "Niemands land" and encouraged listeners to take part in the Internet discussion.

In the second phase of the discussion the participants were asked six questions related to the problems in Niemands land explained in the previous chapter. The aim of this phase was to decide "what do we want?" about: the tunnel for HSL, the tunnel for the A4, the construction of the railway for Rijn-Gouwe lijn, the urbanization of Niemands land, and new locations for water storage. The questions were put in the form of statements and the participants were supposed to agree or disagree with the statements. This phase did not succeed because of problems with the design of the VPRO website.

We managed to put the questions onto the website, but to access them was so complicated that even we as the organizers had great difficulties in reaching them. The 'digital' department of the VPRO Company was still busy developing the website at the time when we started the Niemands land discussion. So the forum was changing the web address, changing the way it could be accessed, it was difficult to find one's way around the overall VPRO site, and the statistics engine did not work. All this was accompanied with several server crashes which lasted several days.

The last phase of the discussion was planned as a choice of actions: the question "what we will do?" was to be answered. To that end we decided to offer participants several design solutions and ask them to vote for one of them. The designs were the work of students of the Deltametropolis studio of the Faculty of Architecture in Delft. We engaged the students, explained the situation to them and asked them to propose solutions for Niemands land. This happened during a one-day workshop on 7 March 2000. The students produced five designs for the area, which can be seen at the VPRO website, and also on the site of the Deltametropolis studio at: http://www.bk.tudelft.nl/ai/deltametropool/TOOLS/Events/Workshop7maart.htm. Marjoke Roerda recorded the workshop as a radio program which was broadcasted on 16 May 2000, and can be still heard on the VPRO web site, at: http://www.vpro.nl/rastreams.-db?2635473.

Unfortunately these designs could not be judged and accessed by the participants in the discussion for the same reasons as mentioned before, so the whole discussion came to an end without being completed.

4.6.4 Results and conclusions

Looking at the course of this case study we can conclude that the TU Delft and HMD Association made a good plan, which, in our estimation, had great chances for success. The informational material was prepared seriously and put on the website in good time. The radio program that was broadcast on 8 February 2000 was very interesting and introduced the problem in a good way. The participants in the program were carefully chosen to represent all aspects of spatial planning involved in this case. The students of the Deltametropolis design studio were very productive during the workshop, found the assignment very

[17] The radio program was broadcast on 8 February 2000. The participants were: Ir. E. Hinborch, senior regional planner of the South Holland Province, F.J.A. Uljee, elderman for spatial planning of the municipality Rijnwoude, J. Kerkvliet, farmer and chairman of the Association "Agrarisch Natuur- en Landschapsbeheer Wijk en Wouden", M. Firet, from "Staatsbosbeheer", P. Vesters, from the Foundation "Nationaal Contact Monumenten", Mrs. L. Vonk, Antiekboerderij Hoeve Rijnland - the owner of the farm where the radio program was recorded, and Prof. Ir. D.H. Frieling, professor at TU Delft and chairman of the Het Metropolitane Debat Association. The program was recorded by Marjoke Roerda and can still be heard in the archives of the VPRO website, at: http://www.vpro.nl/rastreams.db?2434433

interesting, and produced five alternative design solutions which were put on the web the same day.

Bu, the problems with the VPRO website started from the very beginning and could not be solved until the end. To date they have not been solved, and after a year of work on it the structure of the site still causes confusion and runs extremely slowly. The problems with the website arose because VPRO's internal department for the web design developed it in a very complicated way, and did not listen much to our suggestions. As it is attached to a database it could not easily be adjusted for purposes other than those of 'Open Place' forums. The HMD Foundation found the scheme of the VPRO forum to be not suitable enough to accommodate the method as it was designed for this case. This all led to the failure of the Internet discussion. Finally the organizers decided to postpone the Internet discussion to a time when all the problems are solved, or otherwise to abandon it completely. To date the discussion is still in the same status, which means that all the material is still available on the VPRO website, but there is no forum on it.

4.7 Requirements for the Delta•M DSS based on the case studies

This set of the system requirements is formulated on the basis of the HMD case study. The other three cases were not so important for the definition of requirements. They were, however, a rather good practical preparation for the technical development of the Delta•M prototype. Therefore we are not stating requirements from those three cases.

For the HMD method we have defined two kinds of requirements: requirements based on the essence of the method, and requirements derived from the analysis of the implementation of the DSS in the HMD method.

The five essential characteristics of the HMD method which are used in the Delta•M DSS development concern the following:

1. Differentiation of the scale levels of plans – perspectives and projects - and their interrelationships.
2. Recognition that different scale levels have different grades of influence:
    - perspectives only give direction to the spatial development
    - projects are concrete spatial interventions
3. Recognition that different scale levels involve different actors and different kinds of responsibilities:
    - perspectives: predominantly public (voting) projects: predominantly private (investments)
4. Differentiation of three phases in decision making:
    - individual opinion forming (study room)
    - negotiations (dealing room)
    - evaluation (parliament)
5. Recognition of the necessity to choose development strategies on both the individual and collective level (strategy = perspective + projects portfolio)

The requirements presented in Table 4.3 (at the next page) are based on analyses of the implementation of the Sprekend Nederland and Waterproof decision support systems in the HMD method. In the table, each advantage, corresponding disadvantage and related requirement is marked with the same number (for example, advantage no. 1 and disadvantage no. 1 are related to requirement no. 1, and so forth).

Advantages:

1.	Cooperation between HMD and the LWI provided multidisciplinary expertise and the latest technologies in the development of the Sprekend Nederland DSS.
2.	Development of the Sprekend Nederland DSS progressed simultaneously with the development of the HMD method.
3.	The concept of the Sprekend Nederland DSS was based on the use of different software available on the market, which is stable but inflexible.
4.	The Waterproof DSS was simple to use.
5.	The Waterproof DSS worked much faster than Sprekend Nederland.
6.	The Waterproof DSS was better integrated into the decision-making process than Sprekend Nederland.

Disadvantages:

1.	The Sprekend Nederland DSS had overwhelming goals and became a complicated ensemble of parts that could not function as a whole.
2.	The team that developed Sprekend Nederland could not properly combine expertise in method development and tool development.
3.	The concept of Sprekend Nederland was rigid and applicable only to a predetermined set of data. No updates of information were available.
4.	The generalizations that were made in order to simplify the system caused doubts about the competence and reliability of the Waterproof DSS.
5.	The speed of the Waterproof DSS was at the expense of visualizations of spatial data.
6.	The HMD organization, which developed both DSSs, was not used to fully implementing DSSs in the decision making process, which led to confusion.

Requirements for the Delta•M DSS:

1.	The Delta•M DSS should integrate different parts and different technologies in order to function as a whole.
2.	The Delta•M DSS requires a multidisciplinary approach, including experts in spatial planning who also have experience in building decision support systems.
3.	The concept of the Delta•M DSS should be dynamic so as to be able to respond to frequent changes and information updates .
4.	The Delta•M DSS should use information in its full form, not simplifying data and relationships. But it should use models and agents to filter the information according to users' needs.
5.	The Delta•M DSS should use advanced technologies for the visualization of spatial information so that the quality of representation and speed of the system do not come into conflict.
6.	The Delta•M DSS should be carefully integrated into the decision-making process. The questions of who, when, how and in what phases of the decision-making process should be answered beforehand.

Table 4.3 Requirements based on the implementation of a DSS in the HMD case study

4.8 General conclusions about the case studies

The four case studies presented in this chapter gave us an insight into the potential involvement of neo-republican citizens in electronic democracy. The cases also showed us the possibilities and problems related to the implementation of information communication technology in spatial planning.

In two of the cases we had problems with the involvement of participants, for different reasons. In the case of the Masterplan Zuidas we sent the survey questionnaire to 90 addresses, and got responses from only 25 people. This is actually not surprising, as the low response to written interviews is a familiar problem in research practice. In the case of the Deltametropolis studio we had a low response from students, where non-compulsory, voluntary work in preparing material for the website was seen as an extra burden. The advantage of their work being presented to the outside world was sufficient motivation for only a small number of students. These two cases could lead us to the conclusion that the readiness of citizens to take part in changes to the way plans are discussed or presented –

whether they are inhabitants of a plan area or designers of new plans – is far from what the theoreticians of neo-republican citizenship and electronic democracy would expect. But we could also raise the question of whether all possible means to attract citizens were used in these cases. And certainly they were not.

In the case of the HMD debates for instance, the response of professionals to participate in a debate was very high. We cannot say anything about the number of participants in the Open Place case study, but concerning the fact that it was also supported by the HMD Association and VPRO broadcasting company, we can be almost certain that it had very good chances to involve about a thousand participants. So how did the HMD Association manage to attract citizens?

The success of the HMD Association lies in several reasons:

1. The action of the HMD Association came at the right moment, when dissatisfaction with currently used decision-making procedures became an urgent issue on the political and professional agenda.
2. The idea of the new decision-making method was novel and refreshing.
3. The management board of the Association consisted of well-known experts, and each of them had a network of contacts.
4. The organization of the HMD Association made great efforts in contacting and stimulating people to participate in experimental try-outs of the method:
   - each potential participant was personally invited;
   - all participants were constantly informed about the debates and other activities of the Association;
   - participants were very often contacted by the Association, either to reply to questions or to attend meetings, presentations, debates etc., so the contact had continuity;
   - in the first year, the Association published a very well designed and broadly distributed newsletter providing the latest information.
5. A lot of media work was done in order to promote the method and debates, such as coverage in newspapers, radio and TV, presentations, interviews etc.
6. The days when a simulation game took place were organized in attractive locations (such as the newly open building of the New Metropolis center in Amsterdam) with very good service. The opportunity to spend a day together with over a hundred top professionals and have personal contacts, an interesting subject of discussion and pleasant surroundings certainly attracted a lot of people.
7. After the simulation, the Association maintained contact with the participants, informing them about the results of the debate and new activities of the Association.

Usually a very small number of people take part in real public discussions about spatial plans. The only mass reactions are when citizens feel threatened by a new plan (for instance the referendum about the Yburg project in Amsterdam), while people who are positive about a plan tend to get involved very rarely.

In an experimental situation, such as the four case studies of this research, there is no real urge for people to participate, and there is no direct motivation to do so. Therefore a lot of efforts have to be made to attract a large number of participants. To put it simply: no stimulation – low participation. Hence the four case studies have taught us that the involvement of neo-republican citizens in decision-making processes is not a self-fulfilling act. It has to be organized, stimulated, cherished and kept in continuity.

The case studies also gave us an insight into the issues related to the implementation of information communication technology in spatial decision making. Here too, each of the cases had its specificity.

In the case of the HMD we can talk about the development and implementation of the complete DSS and its implementation in practice. The case of the Deltametropolis website concerns the presentation of spatial plans, and the 'Open Plek – Niemands land?' case concerns the application of the Internet in spatial planning. The case study of the Masterplan Zuidas shows citizens' opinions about the Masterplan and gives an indication of possible citizen participation in Internet-based spatial decision making.

As only the HMD case involved a real DSS in the decision-making process, we will consider some aspects of this case in relation to the theoretical framework of this research.

During the course of three years, the HMD Association developed two decision support systems to support the method: Sprekend Nederland and Waterproof DSS. The implementation of Sprekend Nederland was a failure, mostly because of overly ambitious goals that were imposed on the system, which made it too complicated, technically unstable and user-unfriendly. The second version of the similar DSS, the Waterproof DSS, was simple in its graphical presentation but stable and well integrated in the decision-making process. Actually the HMD simulation would not be able to function without the DSS, which shows that the Waterproof DSS has become an essential part of the method.

The HMD method is itself based on the premises of the pluricentric model of decision making and neo-republican citizenship. The Waterproof DSS could accommodate some aspects of these theories. They are as follows:
Participants in the HMD simulation could find all the required information about projects and perspectives in the DSS. They could see some estimation of the spatial impacts of those projects and perspectives, which could help them to choose alternatives. The system was set up to record every action on a certain project, such as the status of the permission issuing, realization of the projects, rejection of the project etc. Therefore all the 'actors' in the network could record their own actions and see the actions of other actors. This shows that the theory of pluricentrism, in which information, legitimacy, and means should be shared between independent actors, was properly supported by the Waterproof DSS.

Usually, negotiations in decision-making processes occur in direct human contact. This was also the case in the HMD simulations, where participants ran through the simulation room to find one or more 'co-investor' in order to be able to realize a project. In this respect, direct contact was much faster and more productive than would be, for instance, communication and negotiation via e-mail in the same room. But as soon as participants in the simulation found co-investors and collected enough money to realize the project, they had to record it in the system so that other participants knew that this particular project was 'taken'. The advantage of this kind of action was that it gave a strict framework of action to the 'decision-makers', provided transparency and improved the structure of the decision-making process. The fact that the transactions are visible to all community members would satisfy the demand of van Gunsteren for the control of the 'governing' of citizens by other co-citizens.

Looking at the problems of participation and the implementation of DSSs, we can assume that it is most likely that an ideal DSS which is properly integrated in the decision-making process can, on the one hand, force participants to take part in the process, because otherwise they would be 'out of the game', and on the other hand, the DSS can attract them to participate because they will have insight and control over the process and other participants.

In this chapter we have defined the empirical framework of this research. Together with the theoretical framework described in the first part of this research, this gave us the context and directions for the development of the Delta•M DSS tool. The following part of the research will present the conceptual tool design and the development of the prototype of the Delta•M DSS.

Part four –

Conceptual tool design and prototyping

Chapter 5. The Delta•M Decision Support System: requirements and the conceptual model

In the previous three chapters we have explained the concepts that were the starting point for the development of our tool, the Delta•M Decision Support System. Based on these premises we can define Delta•M as a DSS aimed at helping neo-republican citizens in dealing with spatial development problems through the employment of a pluricentric decision-making method, via electronic networks. This definition is derived from the theoretical background of this research. But to be able to develop the conceptual model of the Delta•M DSS we had to translate the theories into some kind of operational framework. This operational framework is defined by the tool requirements presented in the conclusions of Chapters 2, 3 and 4. The requirements gave us several development lines which we combined into one system. This chapter presents this process and the results of the process.

The development of the Delta•M DSS consists of two phases:

- In the first phase, the conceptual model of the Delta•M is developed and specified.
- In the second phase, a prototype of a part of the Delta•M conceptual model is developed practically by using Adriole's (1989) prototyping method.

This chapter will discuss the development of the conceptual model of the Delta•M DSS. The prototype of the Delta•M DSS will be presented in Chapter 6. But before we start explaining the conceptual model of Delta•M, we have to digress slightly and explain the context in which it should be placed.

5.1 The context of the conceptual model of the Delta•M DSS

The Netherlands has a strong tradition in spatial planning, and spatial development is regulated by laws and rules which are defined for every spatial unit, from the national to the municipal level. The result is that there is a huge amount of spatial plans of all kinds – a national policy document on spatial planning, structure plans for policy sectors, regional, structure and master plans, local land use plans, and so forth. Annual investments in the physical transformation of the country amount to some 30 to 40 billion euros, where 80% are private and 20% public investments.

There are currently several attempts to deal with information about on-going plans on the national level, which are very important movements in improving the efficiency and democratization of spatial decision making. These are:

- The Large-Scale Basic Map of the Netherlands (*Grootschalige Basiskaart van Nederland* - GBKN) developed by the Association Basis Kaart van Nederland, which was established by the Dutch government in 1975;
- The New Map of the Netherlands (*De Nieuwe Kaart van Nederland*) developed by the association Nieuwe Kaart van Nederland;
- Digital Exchange of Spatial Plans *(Digitale Uitwisseling Ruimtelijke Plannen* – DURP); developed by the National Spatial Planning Agency (RPD); and
- Information Model Spatial Planning (*Infromatiemodel Ruimtelijke Ordening* – IMRO) developed by the Association Ravi (*Overlegorgaan voor Vastgoed Informatie*) in 1997.

The Large-Scale Basic Map of the Netherlands (www.gbkn.nl) is the most detailed topographic map of the Netherlands, in which urban areas are presented in the scale 1:500 to 1:1000 and rural areas in the scale 1:2000. The map represents the current situation, is produced using Microstation software, and it is available in three file formats – dxf, dgn and dwg. The map gives topographic information only and it has not been tested to verify whether it can be imported into a GIS software application without any problems. If that is the case then the future user would be able to add other data to it, according to his/her own needs and interests. The purpose of the map is to provide accurate information about the current state of the terrain to planners, authorities, cadasters, KPN, Nutsbedrijven, real estate developers and so on, i.e. anybody who has to deal directly with the use or development of space. The map was completed in 2000 and will be updated continuously.

The New Map of the Netherlands (www.nieuwekaart.nl) is an overall inventorization of the spatial plans for the Netherlands. The plans cover four themes: housing, work, nature and recreation, and infrastructure. All the plans made by municipalities, provinces, ministries and urban design offices will be put into a GIS system which will be accessible via the Internet. The New Map should present the plans made for the period till 2030. The map will be ready by the end of 2001. A similar map was already made in 1997, with the plan horizon extending to 2005. The map which is currently under development is in a way similar to the previous one, although it consists of two parts: the first part is the map and the second part is the database. The database is connected to the entities in the map so that the user can find information about the plan as a whole and also about the parts that deal with housing, work, nature and recreation, and infrastructure. The aim of the New Map is to provide an overview of the plans for the whole country and thus be used as a means of public communication. This communication of information is supposed to support both government and market parties in their policy and investment decisions.

Digital Exchange of Spatial Plans (www.digitale-plannen.nl) is a project that was started in 1999 by the National Spatial Planning Agency (RPD) and involves the cooperation of state, provinces and municipalities. The aim is to make the complex spatial planning process more transparent and accessible for citizens and policy makers. This will be achieved by putting all spatial plans in the country into a standard digital form so that they can be easily exchanged, compared, manipulated, updated and so on. The expectations are that by the year 2005 about 70% of plans, and by 2010 all plans, will be available in digital form. The advantages of digital plans, according to the RPD, are that governments can make their plans in a better, cheaper, faster and more frequent way. The testing and approving of the plans of lower authorities by higher authorities can also be speeded up. It would be technically easier to adjust local land use plans with neighboring areas and regional and national policy. Digital plans will bring advantages for all parties in spatial planning: citizens, governments and businesses. Citizens will be able to access digital plans for their municipality through the Internet, municipalities will be able to improve their services and accessibility of information, and provinces will be able to test and compare their plans easier. All in all, concludes the RPD, this will result in more democratic interaction and more efficient procedures.

The three projects described above are, in a way, related and coordinated. They are informed about each other activities, their web sites are mutually linked, but most importantly, they all intend to use the same standardization method for the representation of spatial data. This method is called Information Model Spatial Planning (IMRO) and it was developed in 1997 by Ravi. Ravi argues that the establishment of a common language for all spatial planning organizations will enhance the exchange and communication of plans. The language that RAVI proposes is actually a terminology of spatial planning already broadly in use, which describes a huge number of 'objects' in an unambiguous manner using standard words. The IMRO project thus proposes uniformity and standardization in the presentation of digital spatial plans, so that they can be exchanged and communicated easily.

The current state of the art with the projects is that all the four projects are to a greater or lesser extent still in evolution, as the nature of an up-to-date database is to be under permanent development. There is quite a lot information about them available on the Internet, but with very few examples of concrete information and digital data which are in their databases. GBKN's data is very expensive[1], the New Map will be put on the Internet by the end of the year, and the DURP data is not available to the citizens. This means that data aimed at a broad range of users will remain the privilege of those who can afford it. The proposed democratization, which was supposed to occur though

[1] The prices of data from GBKN vary depending on location, recentness of data and size of the area. For example, one hectare of data for the urban area of the Municipality of The Hague, which is updated approximately once a year, cost 30 euros plus administrative costs which range from 100 to 300 euros, depending on the number of hectares required. The New Map of the Netherlands will be available on the Internet with all standard data described on www.nieuwekaart.nl But if one would like to add information to it or to transform it, this has to be paid for and the costs are not yet known. Just for reference purposes, the digital form of the New Map from 1997 costs between 5.000 and 10.000 euros.

the interaction of citizens and governments is at this moment minimal, as it only can be achieved by sending an e-mail message to the organizers of the projects.

Yet these developments, if they continue the way it is planned, could finally result in a huge national spatial information system, which will contain information about the current topographic situation, all spatial plans up to 2030, all presented in an easily exchangeable and understandable form. This does indeed sound very promising, but there is still a long way to go and there are many undefined questions left open, such as: who will use the information, and when, under what conditions, and how; would information be offered to everyone or would it be selectively accessible? Another question concerns how the interaction between the government and citizens will be realized so as to indeed improve the democratization of spatial decision making. And finally, would this amount of data cause information overload and how can this be dealt with, as comparing plan by plan and merely looking at information about each of them seems to be an endless action.

This research looks at the possibilities for improving such huge information systems by adding new functionalities to the data representation and data retrieval by making them easier to use and interact with for both professional and layman users. At the same time, the movements in Dutch spatial planning policy such as those described above give more ground to this research to be realized and implemented in practice.

5.1.1 Perspectives versus projects

To understand the conceptual model of the Delta•M system we have to explain the relationship between two kinds of spatial plans: PERSPECTIVES AND PROJECTS[2].

One of the requirements derived from the HMD and partly from the Masterplan Zuidas case studies, is that for a good understanding of the interdependence between different kinds of spatial interventions, it is necessary to make this dependence obvious and clear to decision-makers. In the case of Delta•M we are adopting the approach that HMD developed – the classification of spatial plans into two categories: perspectives and projects. Although we adopt this classification in the way that HMD did, the question of how to establish the relationships between the perspectives and projects so that their mutual influence can be seen and measured by a computational system, still remains open for future research.

Perspectives are descriptions of conceivable developments in the future, which represent desirable policy intentions. As they are long-term and large-scale spatial plans (such as the Fifth National Policy Document on Spatial Planning - *Vijfde nota ruimtelijke ordening*, the National Structure Plan for a Policy Sector – *Structuurchema*, etc.), it is most unlikely that they will ever be fully realized. Nevertheless, perspectives are very important as a recognizable frame of reference for the realization of other kinds of spatial plans, in this case called projects.

Projects are concrete spatial interventions that are defined in extent and time so that they can be executed by a principal. Projects concern architectural objects (houses, offices, schools, hospitals, factories etc.), infrastructure objects (bridge, tunnel, road, railway), landscape objects (park, forest, nature area, tree line etc.) or water management objects (waterway, channel, dike, lake, pond etc.), or a combination of these.

[2] In a sense perspectives and projects can have a confusing similarity with scenarios and strategies. It is commonly accepted that a scenario is a coherent collection of long-term developments beyond the decision maker's control, and a strategy is a coherent collection of decisions which are almost irreversible over a long period of time. In this research though we have adopted the terminology of Frieling (2001), where the following definitions are given for these terms:
scenarios are prognosis of probable socio-economic development for areas of considerable size and periods of considerable time that are beyond human regulation
perspective is a program for a desirable socio-economic development for areas of considerable size and periods of considerable time that are beyond human regulation, specified in a map and /or other types of visual presentation of the environmental quality that is desired.
Project is an intervention in an existing environment, organised as an entity according to human planning and regulations.
Project portfolio is a combination of projects, aimed at realising a certain perspective.
Strategy is a combination of a perspective with a project portfolio.

Political perspectives are used to allot public money, whereas projects can be realized in most cases only when private and public investors cooperate. As in reality the interaction between desirable future (perspectives) and concrete proposals (projects) leads to the transformation of space, we can consider the choice of perspective(s) in combination with projects as a strategy to deal with the future spatial development of a territory. In that sense, when a participant(s) in a decision-making session selects a perspective(s) and/or project(s) it is considered to be a final decision.

5.2 Conceptual model of the Delta•M DSS

The aim of the Delta•M DSS is to help users (in this case a designing system) to deal with spatial information overload, to get an insight into alternative solutions, to develop criteria to compare alternatives, to choose solutions according to their preferences and to finally discuss and vote for the solutions in cooperation with other members of the designing system. Figure 5.1 represents the conceptual model of the Delta•M system.

By definition, Delta•M is a spatial decision support system, which consists of a database, a knowledge base, a matching system, and the user interfaces.

The database of the Delta•M system contains the data about perspectives, projects, data about users, and data about procedures for spatial plans. Data about perspectives and projects are presented in various media, where various data visualization techniques will be used.

The knowledge base involves:

- expert knowledge that originates from professional practice in spatial planning and decision making,
- theoretical knowledge represented with models and tools for information processing that originate from fundamental research, and
- empirical knowledge - knowledge gained through experiments with similar decision support systems.

The knowledge base serves as a 'filter' of information. By employing rules derived from all three kinds of knowledge, it helps to classify information in the database so that it can be later used by the matching system.

When the knowledge base is established, the processing of data can begin, in this case by employing an extra device – the matching system, which retrieves the information according to the user's preferences. As a result of this process a list of alternatives is offered to the user – a suggestion accompanied with information about alternative solutions and the way they were selected. This is the first stage in the decision making process – choice on the level of the individual user.

In the second stage, the system enables collective interaction and decision making. The interaction tools such as annotation tools, design devices, communication tools and the voting system will enable direct interaction between the participants in the decision-making process. Users can add comments or new solutions and as the system is on-line, it will be immediately available to other users.

The green line in Figure 5.1 (see at the next page) shows the path of the systems' use: first the database has to be filled with data about perspectives, projects, and procedures for spatial plans. Then the knowledge base has to be established. The matching system will automatically start to work as soon as a user approaches the system via the user interface. The first data about user's actions will then be registered by the system, as well as the record of his/her output result and interaction with other users. The database of the system will therefore permanently grow with new information which originates from users, and the process will continue in that dynamic way until the end of the decision-making procedure.

In the following text we will explain the components of the system in detail, illustrating some of them with examples from urban design practice.

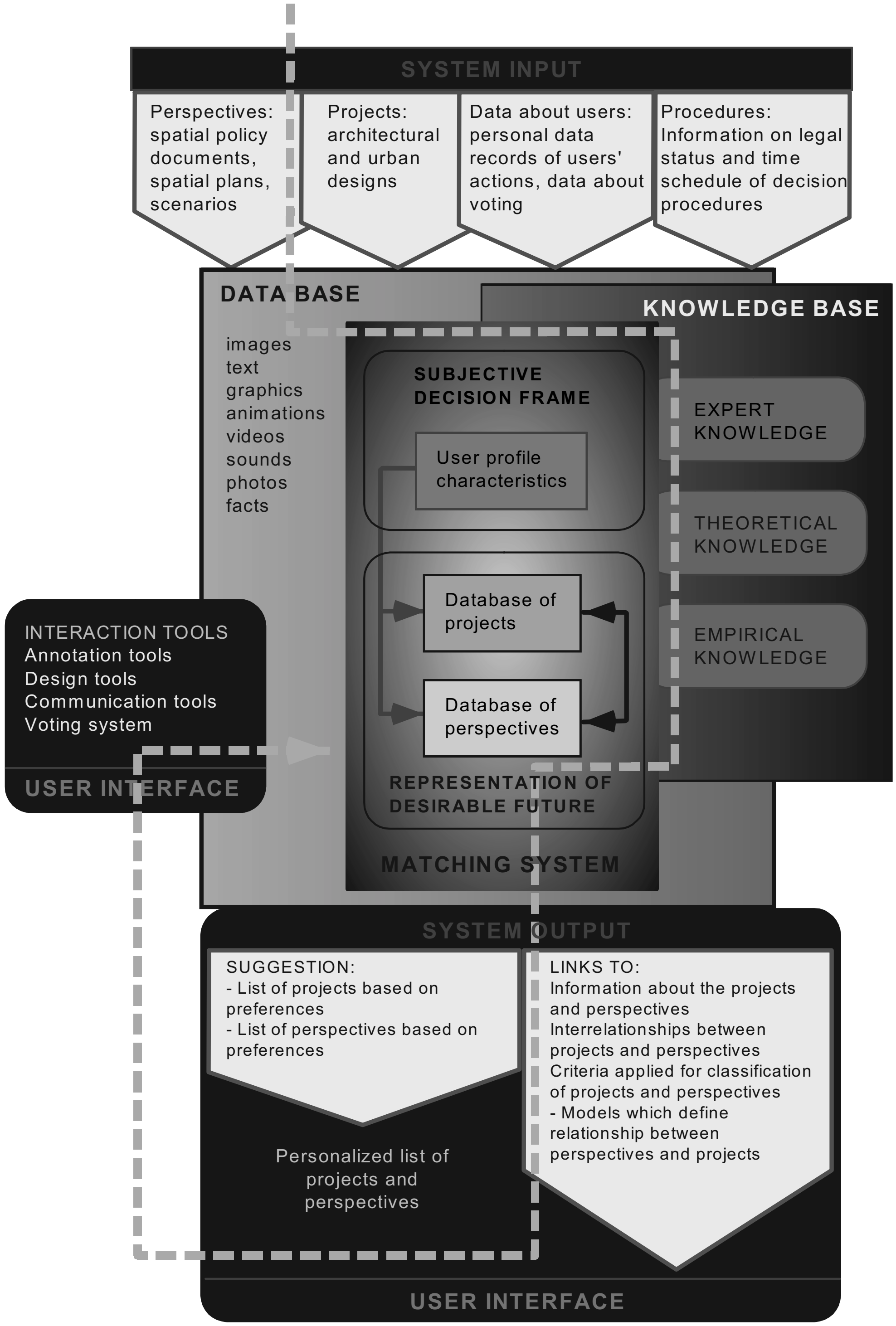

Figure 5.1 The conceptual model of the Delta•M system

5.2.1 System input device and the database

System input is a computer application that enables the operator of the system to enter spatial data to the system's database. It enables easy and quick input of various kinds of data. Data can be in the form of text, numbers or sounds, though most of the data will be of a visual type – maps, drawings, photos, animations, satellite images, and the like. Which data will be entered and in what form will depend on the situation, goals and purposes of employment of the system. As the input device is flexible, it can suit various and numerous planning situations, but generally speaking the systems' database will consist of four kinds of data: data about perspectives, data about projects, data about users and data about procedures. The list below illustrates which kind of data these could be.

Data about perspectives

- Land use (types, zoning, ownership, values/prices, taxes, regulations)
- Transportation system (network types, modes, location and utility of nodes, transfer points, mobility etc.)
- Urban networks (densities, functions, accessibility, urban growth boundary etc.)
- Water management systems (water maintenance systems, water defense, recreational water systems, transportation water networks)
- Landscape and ecological infrastructure (historical, natural, man-made landscapes, dry and wet ecological entities and connections etc.)
- Information communication networks (media, Internet, e-commerce).

Figure 5.2 illustrates the idea of how one perspective can be represented in an integrated image. In addition to this, separate images followed by textual and factual descriptions (Figures 5.3, 5.4, 5.5, 5.6 and 5.7) represent five aspects of the same perspective.

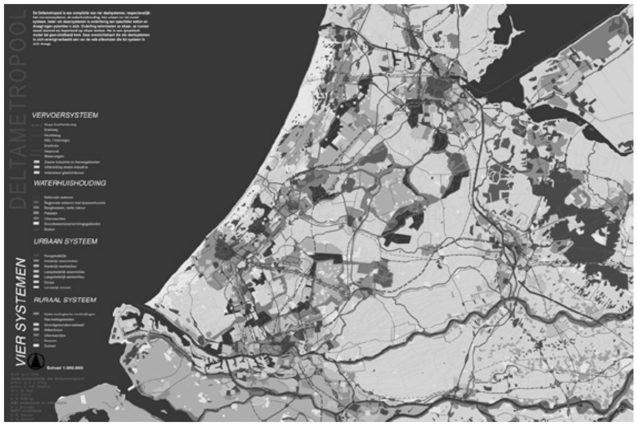

Figure 5.2 A perspective for the Deltametropolis
(Design by Reuser & Schenk)

Figure 5.3 Thematic map of urban system

Figure 5.4 Thematic map of rural system

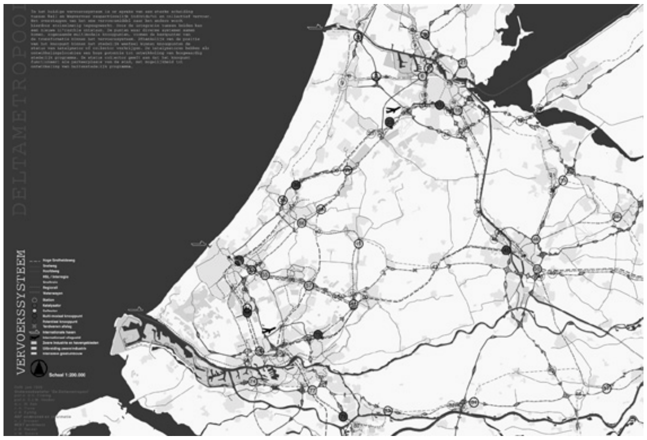

Figure 5.5 Thematic map of transportation system

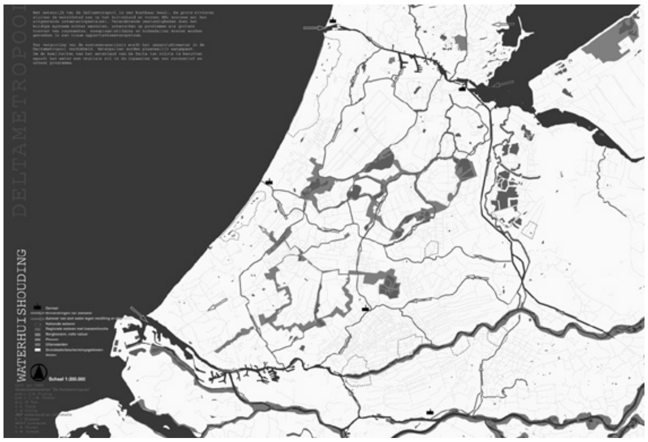

Figure 5.6 Thematic map of water system

Figure 5.7 Thematic map of information system

For the classification of projects different sets of data can be used. The most basic one would be the standard data proposed by Information Model Spatial Planning[3] (IMRO). Here some examples of additional data relevant for this research are given as an illustration:

- Situation (location characteristics, historical, physical and functional context, relation to other entities)
- Size (of a lot, floor area, percentage of site coverage, floor surface index)
- Type (detached, terraced, solitary building)
- Usage (mono-functional, mixed use)
- Function (residential, commercial, services, recreation, culture, education, care)

Capacity (number of households, workers, pupils, patients, passengers etc.)

[3] A detailed description of the standard is published as Ravi Publicatie 00-06, herziene versie oktober 2000; Cd rom met IMRO classificaties, bijhorend bij Ravi publicatie 00-06; en boekje 'Digitale Uitwisseling in de Ruimtelijke Ordening – IMRO'.

Data about users
System users are in this case participants in a spatial decision-making process. They can be professional planners or designers, politicians, investors, representatives of a civil society group or just individual citizens. In principle the participation is open to all interested parties and, theoretically the number of participants that will define the size of the designing system depends on the scale and the scope of the spatial plan in consideration. Participants can have either one or multiple roles in this process. For instance, in the case of HMD, the participants always had three roles: as an inhabitant, as a citizen and as an actor. This possibility is also present in the Delta•M system, but it is not strictly predefined and can be adjusted to other decision-making methods.

Data about users is needed for two reasons. One is to keep a record of their actions so that they can be recognized by the system and when they return to the site they can find what they did previously. The other reason to collect data about users is to learn from their preferences in order to be able to improve and further develop the knowledge base and the matching system.

The data about users would contain:
- Personal data (such as age, sex, profession, e-mail address, education level)
- Settlement patterns (place of birth, living place, number of moves - verhuising),
- Preferences towards different aspects of urban environment (density of urban environment, use of urban environment, distribution of landscape and water areas, accessibility), and
- Socio-economic values (economic efficiency, ecological sustainability, social equality and cultural diversity.

Data about procedures
This data is related to the legal status of the decision-making procedure in which the Delta•M system will be implemented. It should provide users with information about the rules and regulations, phases, duration, and decisions which have already been made and which remain to be made in the procedure, and so on.

The first input into the database would be provided by the initiator of the decision-making process, which could be the authorities, a planning agency, a design office, a social group or individual citizens. But by the time of its use, the database will be permanently updated with new projects, perspectives and data about users. In this way the dynamics of decision making can be maintained as both data and process will be captured, recorded and recalled when necessary.

5.2.2 Knowledge base

The knowledge base of the system is used in relation to the database. It 'filters' information according to the tasks the system has to perform. Development of the knowledge base can be founded on theoretical, expert or empirical knowledge or a combination of these. A knowledge base is used to produce models that will be used to define relationships between the alternative solutions, in this case between the projects, between the perspectives and between the projects and perspectives. Figure 5.8 (see at the following page) shows how models from the knowledge base can be used to extract information from the database.

A huge variety of models have been developed in all the planning fields. It is, however, very difficult to reuse them, for two reasons. They are so numerous that it is extremely time-consuming to test whether one would be suitable for the particular problem in hand. On the other hand, our experience is that most of the models are made in a very rigid way and for one specific situation or purpose. Nevertheless, there are a variety of modeling tools, devices, techniques and architectures available to the designer of the DSS, which allow designers to build their own models. The real challenge though, lies in the extent to which designers can match the right tool with the appropriate problem[4]. As spatial

[4] According to Andriole and Adelman (1995), artificial intelligence (AI) can provide knowledge based support to well bounded problems where deductive inference is required, but it performs less impressively in unpredictable situations. Expert systems for instance (one of them being GIS), can solve low level diagnostic problems and can routinize many simple decision-making processes. Rules about investments, management, and resource allocation, for instance, can be embedded in expert systems, but because of their rigidness a problem emerges each time a slight variation appears.

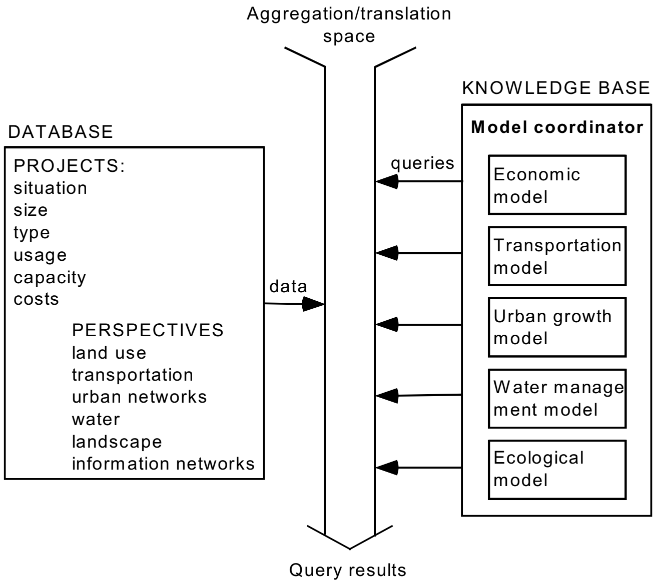

Figure 5.8 Relationship between the knowledge base and the database - the query result can show the relationship between projects, perspectives and projects-perspectives on the level of economy, ecology, transportation, urban development, water management or any other criteria

planning belongs to a group of 'wicked' problems it is very unlikely that simple tools can capture its complexity and dynamics. The tools for modeling complex systems, though, are still the subject of research for many scholars and practitioners.

5.2.3 Matching system

An essential part of the Delta•M conceptual model is the matching system. It is what makes Delta•M different from many existing spatial decision support systems. The specificity of the matching system is that it extracts the information from the database on the basis of users' preferences. In a way it plays the role of an agent - it searches for the optimal solution for a user on the basis of his/her preferences. It is an advisor on the level of individual opinion forming/decision making. The individual opinion of a decision-maker is a vastly influential factor in the collective decision-making process. Therefore it is very important that a participant in the collective exchange of opinions has a clear mind about his/her choices and position regarding others. The matching system 'looks' at the users' preferences and interests, captures and remembers his/her behavior and offers an alternative solution that is the most appropriate for that person. Again, different aspects of users' value systems apply to perspectives and projects, with perspectives being more of an intentional nature, while projects more of a practical nature. The entity relationship model of the Delta•M system shows how this is realized.

In the upper left corner of Figure 5.9 we can see a user who has some personal characteristics which influence his/her choices and decisions. In the lower left corner we see projects and perspectives. The user answers the questions whose options are related to the characteristics of perspectives and projects. Perspectives and projects are also interrelated. The user also has some preferences which are not explicitly related to the projects and perspectives. These are related to the options of questions according to rules. The matching system is in this case represented as a relational database in which the result of a query will be the best matching project and perspective.

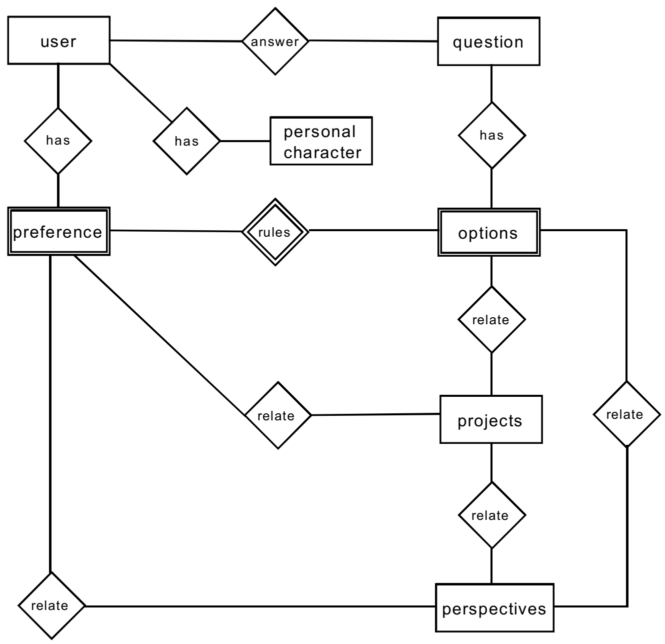

Figure 5.9 ER model of the database, showing relationships between user, projects and perspectives

As with the database, the matching system is related to the knowledge base. Very important for the design of the matching system is the knowledge gained through empirical research into citizens' opinions, preferences and behavior concerning spatial planning, policy forming and spatial design. Here we look for the spatial interests of citizens concerning the following questions:

- Which aspects of spatial planning people recognize (claims for space, mobility, nature, landscape, etc.)
- What spatial characteristics people consider important on which scale (neighborhood, district, city, region, country)
- Which indicators people use to express certain problems (housing density, traffic nuisance, biodiversity, etc.)
- Which prejudices or presumptions concerning spatial problems planners can expect.

In 1997, during the pre-development phase of the Fifth National Spatial Policy Document (*Vijfde nota ruimtelijke ordening*), the National Spatial Planning Agency (*RPD*) published results of its research (*Ruimtelijke Verkeninngen*, 1997) in which some one thousand citizens of the country were interviewed on their opinions of their living surroundings[5]. Tables 5.1, 5.2 and 5.3 (presented at the following pages) present a summary of the findings, while the most important conclusions of this research were:

1. Dutch people want to live in green surroundings, close to nature and without disturbance from traffic and industry.
2. Citizens of the Netherlands are on average very positive about their everyday living surroundings.
3. However, their impression about the spatial arrangement of the Netherlands as a whole is much more negative.
4. Dutch people are concerned that the deficient quality of the environment on the level of the land will threaten their own living surroundings.

Spatial Scale	Neighborhood	Region	Land
Importance			
Very important	Greenery in direct contact Crowdedness Traffic nuisance Variation in housing types	Disturbance from industry (smell and noise) Traffic nuisance (smell and noise) Small distance between house and nature Good public transportation connections Variation in housing types	Pollution Fully building the country Variation in landscapes
Less important	Shopping services in own neighborhood	Social diversity Amusement services Fully building the region	
Not so important	Social diversity		

Table 5.1 Importance of aspects of the living environment according to scale level

[5] Another interesting recent piece of research (results published in June 2000) on public opinion about the spatial development of the Netherlands is the 'Give me some room' project conducted by the Institute for Public and Politics in Amsterdam in cooperation with the 'Agora Europe' foundation. The results are available on the website www.geefmijderuimte.nl. As these appeared when our system was already developed, we did not use them for the knowledge base. Nevertheless, this kind of research on the preferences of consumers regarding space can be very useful for the future improvement of the Delta•M system.

Claims for space
Density of built-up areas; Quantity, closeness and accessibility of green areas; Feeling that everything is going to be built-up, Relationship between the compact city/urban extension to greenery
Pollution Traffic jams Public transportation connections, frequencies and transport nodes
Sustainable economic development
Equilibrium between economic growth, sustainable development of the living environment and internationally concurrent business settlement possibilities Less industry and more clean businesses and services Less commuter traffic as a result of teleworking and shorter job hours. Underground (goods) transport Cleaner cars More use of public transportation.
Age groups Income groups Mixing versus segregation Fragmentation
Nature and landscape
Biodiversity Variation/Change Cleanliness
Closeness Cross-cutting Drying Surviving relative nature development
Relationship between government and citizen
Role of the government, municipalities, provinces and the state. Role of citizens and businesses (*bedrijven*). Who takes decisions?

Table 5.2 Themes of importance and indicators of spatial policy that citizens recognize

The four components of the system that we have described - system input device, database, knowledge base and the matching system - are practically invisible to the user. They are part of the systems' 'back office', and are maintained by a system operator, as shown in Figure 5.10 (presented on the next page). Only some parts of the back office are shown to the user, making the system 'transparent' and thus gaining trust in its operation.

Claims for space
More building always means less greenery. Urban expansion is an attack on nature. Rising urban densities affects the quality of city. Rising urban densities has advantages such as better public transport and more services, but the loss of greenery is more important. Protection of public green areas from the compact city is a must. The growth of urban densities must go hand-in-hand with reinforcing greenery in the direct living environment, and with the increase of accessibility to nature in the region.
Mobility and infrastructure
Traffic is increasing, it will continue to increase in future and this is bad.
Sustainable economical development
Economic growth goes on at the cost of the environment, and thus also at the cost of the living environment of citizens. The Netherlands is polluted. The progress of the economy cannot be stopped because the Netherlands has to develop further if it wants to keep its place within Europe and the world.
Social diversity
The mixing of people of different incomes and age groups is positive.
Nature and landscape
Nature and landscape are under continuous pressure from urbanization, new infrastructure, agriculture and recreation. Intensive agriculture and cities are threats to the landscape and nature. Protection and the sustainable use of biodiversity, nature and the landscape is an important task.
Government and strategy
Spatial policy is a mammoth tanker that is difficult to steer. The Netherlands is a planologic whole. Municipalities should plan urbanization in collaboration, not in concurrence. Citizens have little trust in the spatial and ecologic policy of the Dutch government.

Table 5.3 Prejudices and pressupositions

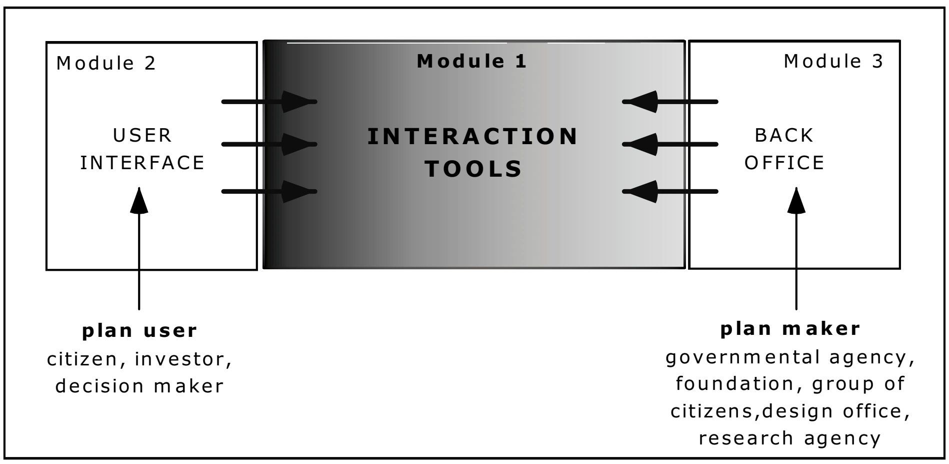

Figure 5.10 The Delta•M system enables interaction between the plan maker or initiator of the decision-making process and the plan user. The plan maker uses the 'back office' to initiate the discussion, while the plan user enters the discussion through the user interface

5.2.4 Delta•M DSS interface

The user enters the Delta•M system via its interface located on a site of the WWW. There he/she will be welcomed by the system, the aim and the content of the system will be explained and the user will be invited to start using it. The use will also be offered the possibility to search the system's database in their own way, if he or she decides not to use the Delta•M DSS.

If the user decides to employ Delta•M for the selection of projects and perspectives, the system can be used in two ways: the user can either put questions to the system that he/she would like to formulate, or opt to answer the pre-defined questions which were set up by the initiator of a decision-making process (Figure 5.11).

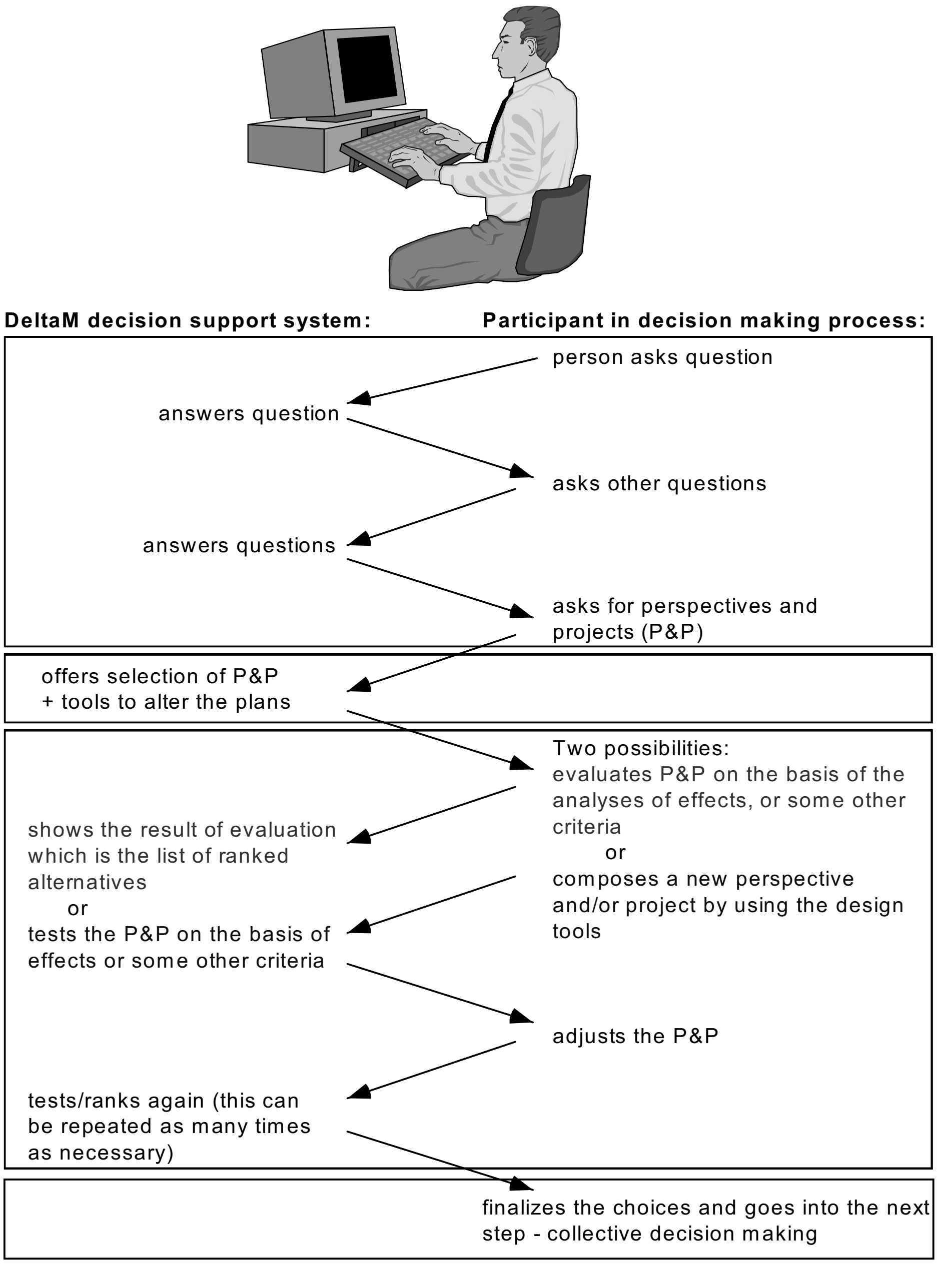

Figure 5.11 Dialogue between the user and the system in which the user is the initiator of subjects of discussion

The scheme in Figure 5.11 is in a way similar to the first phase in the HMD decision-making approach (Chapter 4, Figure 4.5). The difference, though, is that in the case of HMD the questions were fixed and pre-defined. In the case of Delta•M the user can skip them and freely formulate his/her own questions. These will be answered by the system itself, using the knowledge base and to extract the proper reply. It might be that some of the users would prefer to select questions from a menu, because they have difficulties in formulating their preferences in order to find a proper answer. For such users a menu with predefined questions or search terms will be created. In the course of the system's use this menu will be adjusted to the user's needs and the knowledge about the user that system in the meanwhile has obtained.

Whatever course of action the user chooses, the process will end up with suggested projects and perspectives which correspond best to this particular user. This is the end result of the process of the individual's use of the system. The end result can be displayed to the user in either the form of a descending list, where the top listed issues are the best fitting, or as a cloud of context-related information. We stress that the result of matching is just a suggestion, because however perfect a DSS is, it cannot and should not replace human judgement. Thus, from the suggestions, the user is offered several ways to check whether he/she agrees with this, such as information about the perspectives and projects and the arguments and ways the Delta•M DSS has used to arrive at this suggestion.

Once the questions are answered, the suggestions displayed, and the results checked, the user is ready to finalize his/her own choices by setting up the list of priority perspectives and projects. An individual user can select her/his individual project portfolio that supports her/his perspective. This is the result of the first stage in the use of the system – decision making on the individual level.

5.2.5 Tools for communication and interaction

In the second stage of the decision-making process individual users will discuss and negotiate their choices with the other participants in the process so that groups of people will probably form collations that support the same perspective plus the same project portfolio. The second stage begins with the user entering the collective decision-making process, which in the case of Delta•M is enabled by the presence of interaction tools. There are several tools within the Delta•M system that can enable collective interaction: annotation tools, design tools, communication tools and a voting system.

An annotation tool gives users the ability to express their reaction to projects and perspectives in the form of written text or voice recordings. These recordings will be added to the database so that other users can also access them. An example of an annotation interface is presented in Figure 5.12 (see at the next page).

Communication tools such as discussion forums, virtual chat rooms, bulletin boards and argumentation maps are intended for users who want to discuss certain issues among themselves. These tools provide communication with exchange of texts or voices.

Nowadays communication tools can be connected to 3D environments such as virtual worlds or other on-line collaborative design tools, so that the discussion and creation of new proposals (perspectives or projects) can proceed simultaneously. The new or changed plans which would result form such interaction would be automatically recorded by the Delta•M DSS and put as a new option in the database. This means that the system will be able to follow the dynamics of the negotiating process. Just for illustration we are presenting an example of such possibility. This is Active Worlds software, which is already used for research and educational purposes (see for instance www.casa.ucl.ac.uk/olp/worlds, and www.arch.usyd.edu.au). Active Worlds are a good environment for direct interaction by using visual means, but it does not record the changes in a database the way Delta•M DSS would require. In this stage of the development environments such as Active Worlds can only be used for the negotiation phase in the decision-making process (Figure 5.13 at the next page).

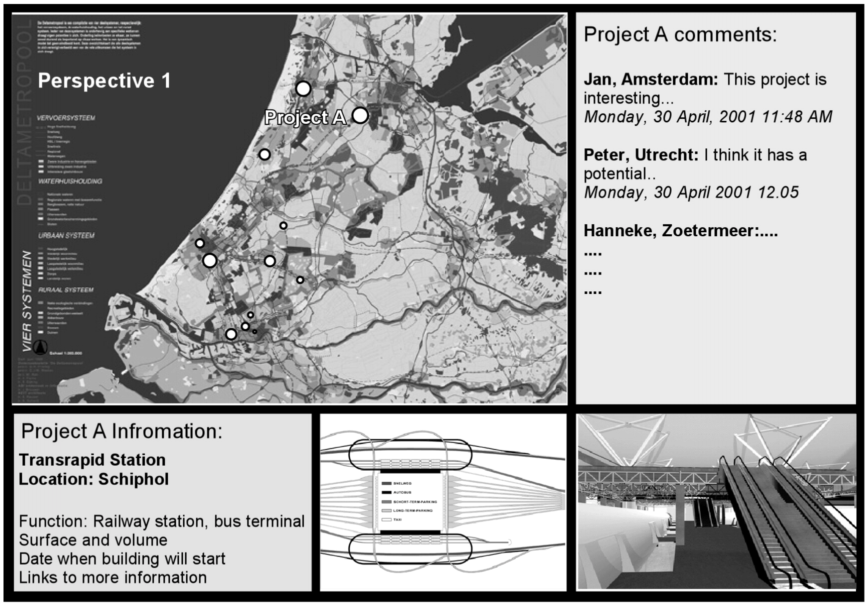

Figure 5.12 The annotation tools allow users to add comments for each project or perspective. By clicking on the map (white circles) information about a project will appear in the lower left corner - the image in the lower right corner is a Quick Time movie that shows a 3D animation of the building. In the middle is a floor plan of the station - the upper right window is for the comments of users.

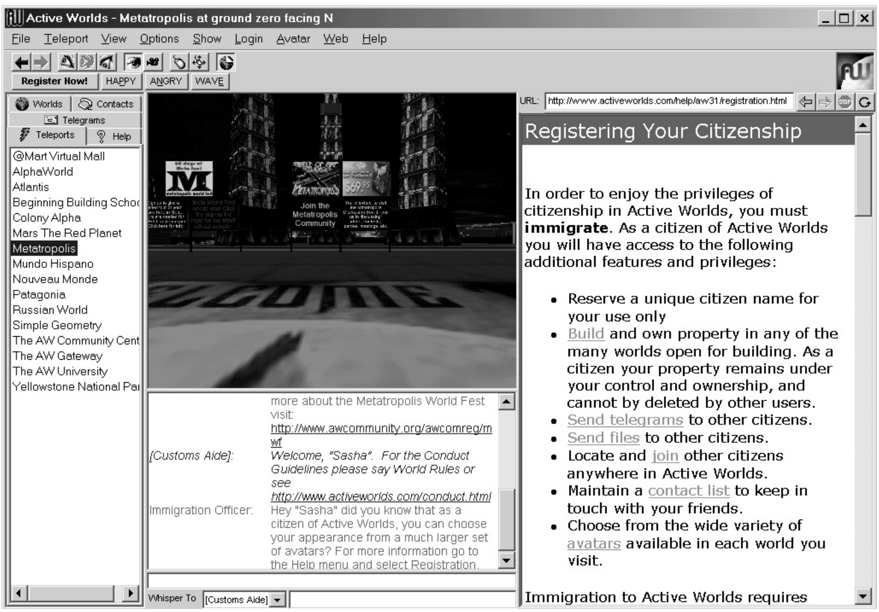

Figure 5.13 Example of a 3D chat room of the Active World, the Metropolis. The user can build a new environment, take different roles (avatars) and engage in discussion with other 'citizens' of the virtual world]. (www.activeworlds.com)

A voting system ensures that the processes of individual opinion forming and the collective discussion end up with a final decision – the common choice of perspectives and projects on the community level. By voting for a number of perspectives and accompanying projects, participants in the decision-making process will make their choices explicitly visible to their co-participants. A sketch of a possible voting system is presented on Figure 5.14.

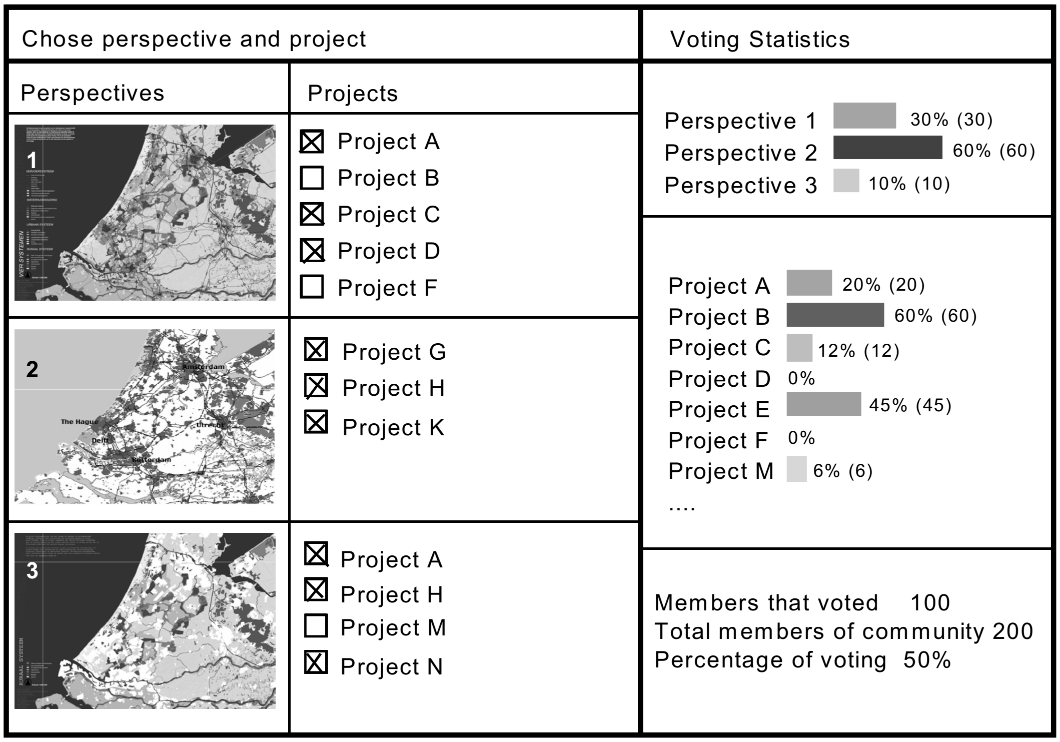

Figure 5.14 An example of a voting system

By counting and displaying the votes and voting statistics, the transparency of the process can be protected and the results are made immediately visible to all community members.

5.3 Technologies that can support the knowledge base and matching system

On the subject of possible technologies for the development of the matching system and the knowledge base, we can say that a large part of the matching system can be already solved by the employment of object database technology. Another possibility lies in the development of systems that use natural language, which enable users to communicate with the database and the knowledge base in the way they address humans and paper data.

In recent years, agent[6] technology has received a lot of attention because it has the potential to execute

[6] The idea of an agent originated with John McCarthy in the mid-1950s, and the term was coined by Oliver G. Selfridge a few years later, when they were both at the Massachusetts Institute of Technology. They had in mind a system that, when given a goal, could carry out the details of the appropriate computer operations and could ask for and receive advice, offered in human terms, when it was stuck. An agent would be a 'soft robot' living and doing its business within the computer's world (Kay, 1984, p. 58). Kozierok and Maes [1993] define an agent as 'a semi-intelligent, semiautonomous system which assists a user in dealing with one or more computer applications'. An interface agent is a metaphor for an agenda or a collection of task-level goals in the computer, imparted to it by the user, and the capability to carry out

advisory tasks the way humans do. Recent developments in the ways that the content of the World Wide Web can be retrieved, called the Semantic Web, would provide the agents with more powerful surroundings for their action.

The World Wide Web was designed with the goal that it should be useful not only for human-to-human communication but also that machines would be able to participate and help. One of the current obstacles has been the absence of accompanying data in the Web to allow robots and other automated tools to interpret the information present on the Web. Most of the web's content today is designed for humans to read, not for computers to manipulate meaningfully, which is the reason why in general computers have no reliable way to "understand" the meaning of the web pages and process the semantics. According to Berners-Lee et al. (2001), "the Semantic Web will bring structure to the meaningful content of Web pages, creating an environment where software agents roaming from page to page can readily carry out sophisticated tasks for users."

Although the semantic web is a vision, facilities and technologies to put machine-understandable data on the web are rapidly becoming a high priority for many communities. Two important technologies for developing the Semantic Web already exist: extendable Markup Language (XML)[7] and the Resource Description Framework (RDF)[8] accompanied with a collection of information called ontologies[9].

According to Berners-Lee et al. (2001), "the real power of the Semantic Web will be realized when people create many programs that collect Web content from diverse sources, process the information and exchange the results with other programs. The effectiveness of such software agents will increase exponentially as more machine-readable Web content and automated services (including other agents) become available."

So what can these new technologies mean for the enhancement of the matching system of the Delta•M DSS?

The technology of the Semantic Web at this moment concentrates on the meaning of the content of Web pages, but it mostly refers to the textual content of web pages, which means that in this technology images would have to be explained with words as well. This is in the case of Delta•M, which deals in the first instance with images and spatial data, a limitation. A limitation, because it is not a problem to describe the whole image, but it is a problem to decompose the image into sub-entities which are, for instance, the elements of a map or a building represented in a 3D image. Therefore for the representation of spatial plans, either other technologies have to be combined with the Semantic Web, or the Semantic Web would have to develop special applications for this purpose.

The first steps towards the exchangeability of spatial data is already present in Dutch spatial planning practice – the IMRO coding language will provide uniformity of data which is understandable to computers. So whatever software platform is used to develop a plan, and whatever color the legend or textual description for the drawing is used, in the database each object of the map also has to be translated into a uniform code prescribed by IMRO. This in effect means that when one map is sent from one user to another, who uses different software platforms and different styles for map representation, the meaning of an object in the map will still stay understandable and unchanged. Hence, if IMRO develops as planned, it would provide a good basis for the Semantic Web as well.

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those, within reasonable expectations. Agents thus represent the ability of the computer to accomplish something on behalf of the user [cf. Minsky & Riecken 1994]. To do this they posses high-level knowledge about a particular task domain or domains. (From: Thorisson, K.R. 1996, *Communicative Humanoids. A Computational Model of Psychological Dialogue Skills,* Thesis, Massachusetts Institute of Technology)

[7] XML is a markup language like HTML, but it lets individuals define their own tags. Scripts or programs can make use of these in sophisticated ways but the script writer has to know what the page writer uses each tag for.

[8] RDF is a scheme for defining information on the web. RDF provides the technology for expressing the meaning of terms and concepts in a form that computers can readily process. RDF expresses meaning by encoding it in sets of triples, each triple being rather like the subject, verb and object of an elementary sentence.

[9] Ontologies are collections of statements written in a language such as RDF that define the relations between the concepts and specify logical rules for reasoning about them. Computers will "understand" the meaning of semantic data on a Web page by following the links to specified ontologies. (Berners-Lee, Hendler, and Lassila, 2001).

For the matching system of the Delta•M DSS it would mean that a computer agent would be able to retrieve spatial data on the whole Web, providing advice based on the meaning of the information and the user's preferences with regard to this meaning.

Another issue in this context is how to present the advice so that the user can easily understand it and quickly decide whether to accept it or to repeat the matching process. As in this research we adopted the view that visualization of spatial information is equally as important as textual presentation; the problem of the presentation of information and advice in visual form also has to be tackled.

There are currently many software applications for the 2D and 3D visualization of spatial plans, urban and architectural objects. The production of high quality images is nowadays brought to an advanced level which allows users to create realistic and detailed models of spatial entities ranging from a building, city district, or city regions to the representation of the whole world.

The problem with those visualizations, however, is that in most cases they are not related to the database. Here we have to say that only with 2D GIS visualizations is this not the case. There, objects of the map are related to the spatial data. But in the case of 3D GIS visualizations this is not yet the case, although several attempts were recently made in this direction[10]. This means that if such visualization is presented to the user and he/she would like to interact with the system, the interaction will occur on the level of drawing but feedback to the spatial database will not be present.

In both 2D and 3D GIS systems it is not possible to develop the 'intelligent' response of the system to the user's actions. For instance, if the user were to draw a road that leads nowhere or to build a new housing area on land with restricted use, the system would not automatically warn him/her that it is a problematic action. It is possible to write such rules into GIS systems, but the rules have to be predefined and as current GIS systems are not self-learning, they would stick to existing rules and would not develop new knowledge from users' actions which they do not 'know'.

[10] Community Viz (www.communityviz.com), CASA research on Active Worlds technology (www.casa.ucl.ac.uk/olp/worlds)

A promising new technology which could solve some of the above problems is Liquid Solutions, developed by a small Dutch company (www.medialab.nl). Liquid Solutions technology uses semantic networks to process information according to users' preferences and then visualizes it in a dynamic way. The most important in the Liquid Solutions set of the tools are the advanced knowledge storage and extraction system IGOR, and a user interface named Aqua Browser. Liquid technology can use elements from different sources and integrate them in the IGOR database.

Aqua Browser is a fuzzy visualization tool which shows the high level description of a concept space hiding irrelevant information and visualizing information elements in context (Veling, 1997). The Aqua Browser is a generic Java applet that can be embedded into any Web page and shows information in context. Medialab claims that users of Aqua Browser can browse through a dynamic concept space that is continually reshaped to meet their interests. By means of animation, transitions from one state to another appear more fluid, showing users why and how the information is rearranged. The user interface displays the information in the form of words, which are distributed in the concept space that the user is interested in. The words are centered and bigger if they are more relevant to the user's preferences, and smaller and peripherally positioned if they are less relevant. Each of the user's actions will change and rearrange the distribution and importance of the words, putting those that are of interest for the user in focus and the less 'interesting' ones further away in the screen field.

The system responds to user actions by adopting the relevances of concepts on the basis of the structure of the information space and user profiles. The user profile in this case is related to knowledge of what the user was interested in before, and his/her background. The applet can also predict where the user will go next and send a request for this information to a server. In this way, the browser 'learns' the user and can shift his/her attention to the issues that are most likely to be of interest.

The advantages of Liquid Technologies that are very relevant to this research are that these tools are able to capture the dynamics of the real world in the database and to display these dynamics in a user-friendly interface. This is extremely important in the modeling of spatial planning problems because each intervention in space is related to many other components within one or more different levels – from the physical, through the economic, to the social and political. A disadvantage of Liquid Technologies is that they do not yet operate with images, and therefore this part still has to be developed to be directly applicable in the Delta•M system.

Bearing in mind the current state of the art in computational methods for knowledge representation, the visualization of spatial data and World Wide Web technology, we can conclude that to achieve an interaction between humans and computers on an intelligent and advanced level, where an action of a human will be responded to by a computer in a meaningful way and in the form of properly visualized advice, there is still a long way to go. Hence for the optimal functioning of the Delta•M DSS these technologies have to be integrated in order to work together. Concretely, the combination of agents which are specifically designed to deal with spatial information, intelligent browsing systems such as Aqua Browser, and high quality spatial data visualization techniques all integrated in the Semantic Web would be the most appropriate way to realize the ideas displayed in the matching system of the Delta•M DSS.

5.4 Conclusions

In this chapter we have presented the conceptual model of the Delta•M system. We have explained the background context of the conceptual model and some movements in Dutch spatial planning practice, which are related to the future development of the database of the Delta•M DSS.

The chapter also explains the process of the design, elements of the system and their function. The database, knowledge base, matching system and user interfaces are discussed. We also considered the latest technologies in the fields of the WWW, computer agents and the visual representation of information, which can be implemented for the realization of the Delta•M DSS in the future.

The Delta•M DSS is designed so as to support both individual and collective decision making. The result of the individual decision-making process will be a choice of perspectives and projects on the individual level. This should be the input for negotiations on the collective level. The result of collective decision making is a final perspective with a portfolio of projects that fit this perspective in the best way. Whether such an outcome will be encountered as a real decision, public opinion or a starting point for a social debate is a question that will be decided by the community itself, either beforehand or afterwards.

A part of the conceptual model of the Delta•M DSS which supports individual decision making is developed as a prototype, using the same premises as for the development of the conceptual model. The following chapter presents this prototype.

Chapter 6. The Prototype of the Delta•M DSS

After the conceptual model of the Delta•M system was designed and specified, we started developing the prototype. Because of a lack of time and resources, we have developed only a part of the conceptual model. Since we consider the matching system the most essential part of the Delta•M DSS, which distinguishes Delta•M from many other systems, we decided to build this part as a prototype. We also reduced the matching system and the database to work only with projects, and we used the graduate projects of students of the Deltametropolis studio (described in Chapter 4.5) to fill the database.

We found development of a working prototype to be extremely important for this research for several reasons. According to Adelman and Riedel (1997), the knowledge requirements needed to build such a system are by definition based on domain-specific knowledge which may exist only in the minds of experts. The prototyping approach in tool development uses prototyping as a way to understand the problem, access the expert knowledge, and obtain feedback to validate the evolving knowledge requirements for the system.

In the case of Delta•M the operational prototype was developed with the purpose of demonstrating practically the function of the tool. In order to ensure the tool's operational stability it is built with technologies available on the market, although the theoretical model relies on other, more experimental technologies. The expectations were that even if it were simple it would be sufficient for users to judge the value of the tool and if so, the prototyping process will continue until the tool is fully set up in the way the conceptual model proposes.

6.1 Prototyping steps

The purpose of prototyping is to quickly develop a working model of the system and get the reactions of users and experts to it in order to find out if the development process is on track (Adelman, 1992). In most cases, prototyping assumes that there will be subsequent versions of the system. Therefore the prototyping can be a circular process, as shown in Figure 6.1.

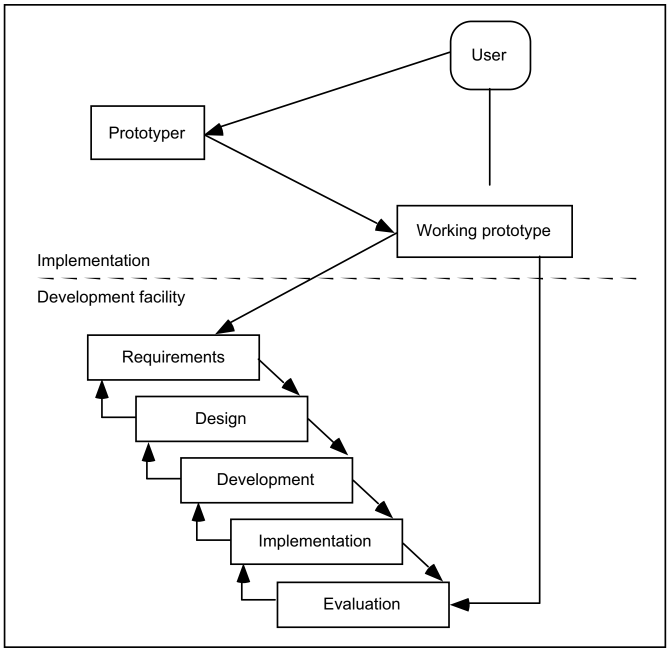


Figure 6.1 Cycles in an operational prototype development (Adelman, 1992)

In the operational prototype a suitable portion of a system is constructed and it incorporates only those features that are well known or understood[1]. This initial version is then made available to users via the Internet. As users operate the system they will discover problems and probably offer suggestions for solving them. The prototype can then implement these improvements through repeated 'development' steps. In this way the system is constantly undergoing performance and usability testing, which should ensure the high quality of the final system. At this stage of development, Delta•M has passed only one cycle in the development facility shown in Figure 6.1.

[1] For instance, the Delta•M prototype deals with the relationship between users and projects, which is based on the empirical knowledge gained from the case studies and spatial planning practice while the projects - perspectives relationship is not built into the system because the knowledge base is not yet developed for this part of the system.

The Delta•M prototyping passed several steps, which are based on Adriole's (1989) nine-step 'prototyping design blueprint' for developing decision support systems. These are shown in Figure 6.2.

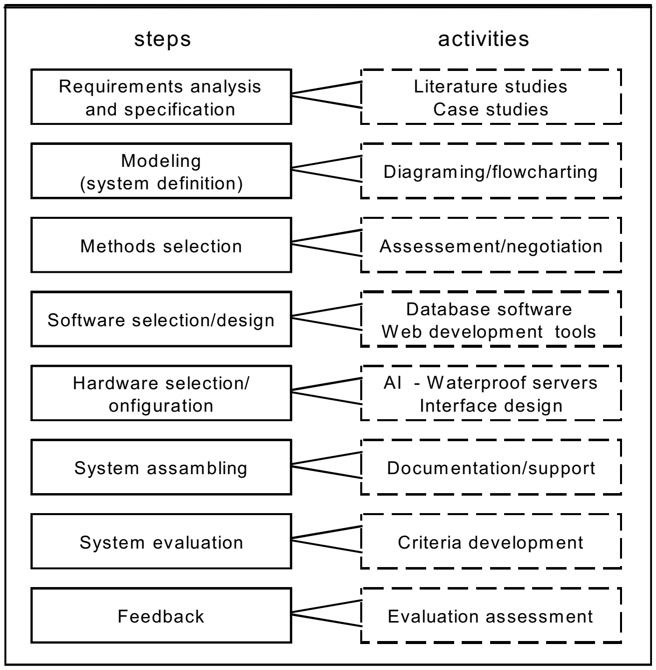


Figure 6.2 Steps in the development of the Delta•M prototype

The first step in the prototyping was to analyze system requirements, which was already done during development of the conceptual model. During the prototyping, the selection of requirements was applied for the part that was under development - the matching system.

In the following steps the matching system was modeled, methods for its development were defined and software and hardware systems chosen.

The next step involved system assembling by putting together different parts; in this case the database, the matching system, and user interfaces were connected and published on the Internet. Finally, the system evaluation criteria were developed and the system was tested and the feedback results processed and analyzed.

6.2 Description of the Delta•M DSS prototype

In the following text we will describe the Delta•M system from different sides, each of them showing one aspect of the prototype development. These are:

- Form: what the system *is*
- Behavior (or function): what the system *does*
- Performance: *how* it does it
- Data model: the information retained in the system and its interrelationships.

Form and behavior are the aspects that define the outside of the system, the side the user sees. The inside of the system, the side that is only partly visible to the user, consists of the performance and data aspects.

6.2.1 The form, data model and performance of the Delta•M DSS prototype

The prototype of the part of the Delta•M DSS consists of three modules: back office, user interface and the matching system with the database of projects. The matching system enables interaction between project makers and project observers in the way presented in Figure 5.10.

The projects maker is in this case the Deltametropolis studio, which initiates the use of Delta•M by setting up the back office of the system. The projects users, in this case invited test users, enter the system through the user interface, the Internet website. The matching system of the Delta•M DSS overlaps users preferences with information about the plans from the back office and produces the output result, which is displayed on the user interface. Figure 6.3 presents the model of the prototype of the Delta•M DSS (see at the next page).

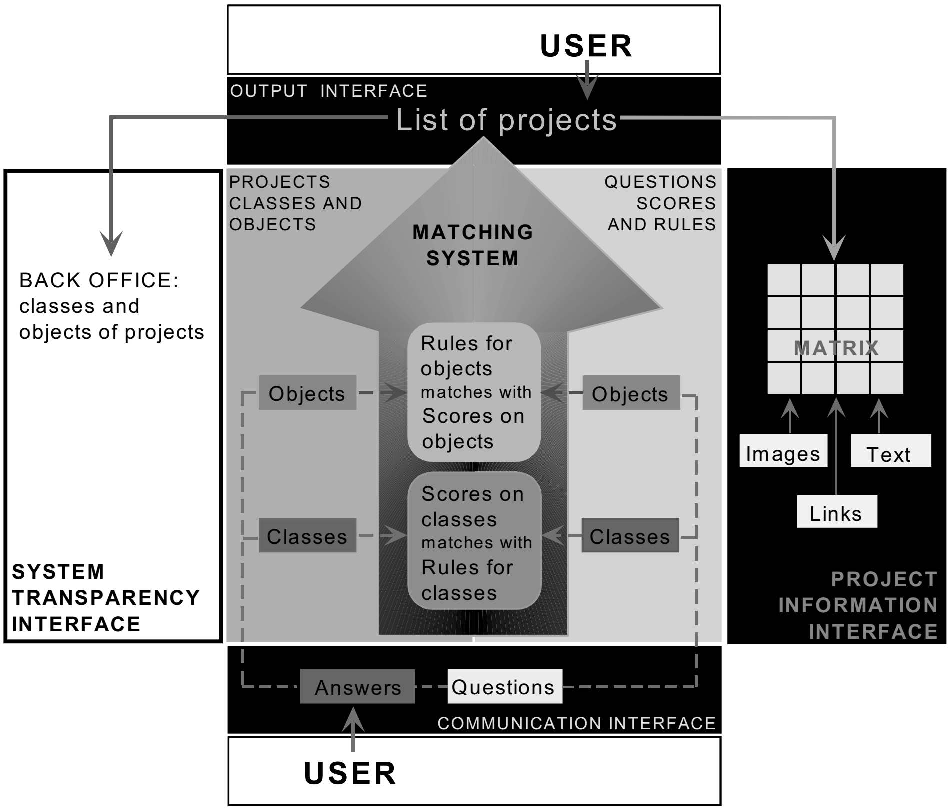


Figure 6.3 The model of the prototype of the Delta•M DSS. The system consists of the back office, user interfaces, the matching system and the database of projects

Back office

At the moment I am the one controlling the back office of the Delta•M system, which means that I control the database input, definition of questions and criteria for the classification of projects. This is because the prototype is still fragile, but normally anyone else could be the manager of the back office. The back office is presented in Table 6.1 (at the following pages) and serves for:

- input of the projects in the database,
- development of the classification criteria,
- classification of projects according to these criteria,
- setting up questions and options,
- defining the rules which connect the options of the questions and characteristics of projects, and
- for the adjustment of the statistics about users' answers.

```
Add Questions    Add Classes    Reset statistics

Classes
1 Activity                                  add object del alter
      care                                             del alter
               houses                                       aler
               hotels                                       aler
               apartments                                   aler
               restaurants                                  aler
               shops                                        aler
      work                                              del aler
               offices                                      aler
               industry                                     aler
               farms                                        aler
      learning                                          del aler
               kindergarten                                 aler
               schools                                      aler
               universities                                 aler
               theatres                                     aler
               cinemas                                      aler
               museums                                      aler
               libraries                                    aler
      sport                                             del aler
               sport centres                                aler
               recreational areas                           aler
               swimming pools                               aler
               centerparks                                  aler
               amusement parks                              aler
  ------------------------------------------------------------------
2 Land use system                            add object del aler
      water                                             del aler
               river/cannel                                 aler
               see                                          aler
               lake                                         aler
      urban                                             del aler
               houses                                       aler
               offices                                      aler
               services                                     aler
               schools                                      aler
               culture                                      aler
               sport centers                                aler
               fair                                         aler
               hotels                                       aler
               stations                                     aler
      landscape                                         del aler
               parks                                        aler
               forests                                      aler
               agriculture                                  aler
               farms                                        aler
               dunes                                        aler
               dykes                                        aler
               nature areas                                 aler
               recreation in rural areas                    aler
      connections                                       del aler
               roads                                        aler
               railways                                     aler
               stations                                     aler
               airports                                     aler
               seaports                                     aler
               tunnels                                      aler
```

```
                tram/light rails                                    aler
                river ports                                         aler
  --------------------------------------------------------------------
3 Location of a building                             add object del aler
      in a big city                                             del aler
      in a town                                                 del aler
      in a village                                              del aler
      in rural area                                             del aler
  --------------------------------------------------------------------
4 Greenery                                           add object del aler
      in my direct surrounding <100m                            del aler
      in the neighbourhood 500 m                                del aler
      not to far away <100m                                     del aler
      not important                                             del aler
  --------------------------------------------------------------------
5 Water                                              add object del aler
      I like water in my direct surrounding                     del aler
      Water does not have to be directly in my surrounding,     del aler
      but within <500m                                          del aler
      within 1000m                                              del aler
      not important                                             del aler
  --------------------------------------------------------------------
6 Accessibility                                      add object del aler
      by car                                                    del aler
      by public transport                                       del aler
      not important                                             del aler

  Questions                            Press here to delete all questions

1.  Our system has information about 8 topics. Four     aler scores del
    are about the space, and another four are about
    activities and use of time. Click on the topics
    that interest you the most.
                Urban spaces                                        aler
                Landscape and greenery                              aler
                Water                                               aler
                Connections                                         aler

       Info: This is an object question with scores on the objects of
       class land use system
  --------------------------------------------------------------------
2. Which activities are interesting for you?            aler scores del
                                                                    aler
                Care: sleeping, eating, cleaning,
                washing, health                                     aler
                Work: earning money, creating, helping              aler
                Learning: educating, culture                        aler
                Sport: play, recreation                             aler

       Info: This is an object question with scores on the objects of
       class activity
  --------------------------------------------------------------------
3. Which kind of city you prefer?                       aler scores del
                                                                    aler
                I like big cities                                   aler
                I like towns                                        aler
                I like villages                                     aler
                I like rural areas and landscape                    aler

       Info: This is an object question with scores on the objects of
       class location of the building
```

```
4. How important is greenery to you?                  aler scores del
                                                              aler
          I like to have it in my direct surrounding      aler
          I like to have it in the neighbourhood          aler
          Greenery is not too important to me             aler
          Greenery is not at all important to me          aler

     Info: This is an object question with scores on the objects of
     class location of the building
  -------------------------------------------------------------------
5. Are you interested to having water (like canals,   aler scores del
   ponds, moats, fountains or recreational water) in
   your surroundings?
                                                              aler
          I like to have water in my direct surrounding   aler
          I like to have water nearby                     aler
          Water is not too important for me               aler
          Water is not at all important to me             aler

     Info: This is an object question with scores on the objects of
     class water
  -----------------------------------------------------------------
6. Please choose the values that are the most        alert scores del
   important to you.
                                                              aler
          Economic efficiency                             aler
          Ecological sustainability                       aler
          Cultural diversity                              aler
          Social equality                                 aler

     Info: This is an object question with scores on the objects of
     class land use system
  -----------------------------------------------------------------
7. How important is accessibility to you?            alert scores del
                                                              aler
          Good accessibility by car is important          aler
          Accessibility by public transport is important  aler
          Not important, I prefer quiet surroundings      aler

     Info: This is an object question with scores on the objects of
     class accessibility

Projects
1. Layered Land                                      alert scores del
2. A Pork Factory                                    alert scores del
3. Transrapid Station                                alert scores del
4. Masterplan Zuidas                                 alert scores del
5. Image Building                                    alert scores del
6. NL Superbia                                       alert scores del
7. Living Bridges                                    alert scores del
8. An Urban Catalyst                                 alert scores del
9. Zuidwijk in de Lift                               alert scores del
10. Wild Living                                      alert scores del
11. Refuge Refused                                   alert scores del
12. Landscape in motion                              alert scores del
13. Systematically Better                            alert scores del
14. Erasmus University Revised                       alert scores del
```

Table 6.1 Content of the back office: Classes, objects and properties; Questions, options and project

The buttons on the top of the list are used in the following way. The button 'add classes' is used to define the main criteria – here called a 'class' – for the classification of architectural and urban designs – here called projects. In the case of this prototype we have opted for six classes: land use system, spatial activity, location of project, greenery, water and accessibility[2].

Each class is subdivided into 'objects' – the smaller entities which together belong to one class, and which specify more precisely the kind of architectural project in hand. For instance, the class land use system has the objects: water, urban, landscape and connections.

The objects can be subdivided into 'properties'. Properties are used to describe objects even more precisely. So the object water can be specified through properties like river, canal, lake, and so forth. By using the button 'add classes' new classes, objects and properties can be added to the system. By using the links on the right-hand side of the page, with 'add object' we can add a new object to an existing class; with 'del' we can delete a class or an object; and with 'alter' we can change the text of an existing class or object.

The button 'add questions' is used to make questions and answering options, which will be displayed to the user via the user interface. In this first prototype we have chosen to ask the user seven questions shown in Table 6.1. Why these seven in particular were chosen will be explained later in this chapter.

Each question is related to some class and object in the database, and therefore a 'score' is given to each option of a question , a value that will be used in the processing of the results of the matching. The links 'alter scores' 'del' and 'alter' can be used to respectively change scores, delete questions, and alter the text of a question.

Behind the list of questions and options in the back office (Table 6.1), we can see the list of projects. Each time a new project is entered into the database the link 'alter scores' is used to define how this project scores on classes, objects and properties. The scores of existing projects can also be changed and deleted by using the links on the right-hand side. The scores of projects and the scores of options of the questions are used to calculate the matching systems' outcome. The algorithm for this calculation will be explained later in the text.

Finally the button 'reset statistics' can be used to set the statistics that show the number of users that used Delta•M and their preferences back to zero. This would be needed in the event that new questions and new projects are added to the system.

User interfaces

User interfaces of the Delta•M system are the 'gates' to the outer world of potential users – members of the designing system. This part of the system is available on the Internet without any restriction. The website is: www.bk.tudelft.nl/ai/deltametropool/deltam.htm

We found the design of user interfaces to be extremely important because most users identify the interface with the system itself and judge the quality of the results on the basis of this. As we already noted in the definition of requirements, the communication between the system and user should be similar to human-to-human communication. There are three kinds of interfaces within the Delta•M system:

1. Interfaces for communication between the user and the system,
2. Interfaces for information about the projects, and
3. Interface for the transparency of the system – the back office.

The interfaces for communication are the first ones the user sees when he/she starts using Delta•M. Therefore, for this first contact we have chosen a kind of very simple dialogue, with a sequence of questions and answers displayed on a black background. The communication interface consists of nine windows. The first window (Figure 6.4) welcomes the user and introduces Delta•M through a short explanation of the system's content, context, goals and use. The next seven windows (Figure 6.5) are devoted to the seven questions about the user's spatial preferences (from

[2] These classes were selected from the long lists of different classification methods and legends of spatial plans, as the simplest way to quickly describe projects, it is of course possible to change and add new criteria for the classification of the projects.

Table 6.1). The user can choose one or more options, submit or reset them. Pressing the 'submit' button means that the system has accepted the answer and at the same time it leads the user to the next question. Navigation back and forth through the questions is enabled by using the browser's 'back' and 'forward' buttons. The ninth communication window is the system output window: it displays the result of the matching process in the form of the list of projects (Figure 6.6 at the next page).

Figure 6.4 Communication interface: the first window with explanation of the prototype

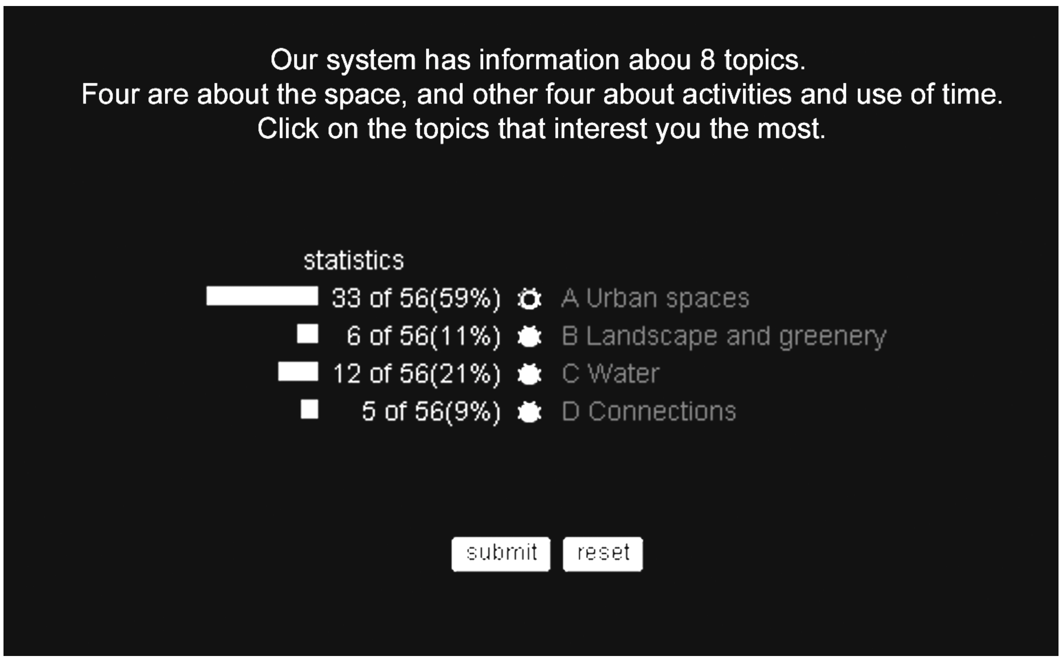


Figure 6.5 Communication interface: Questions about the user's spatial preference

In the list shown in Figure 6.6, the projects are ranked from 1 to 11, the first one being the best 'match'. The percentage next to the project's name (Layered Land met een score van 74.1%) shows to what extent this project coincides with the user's preferences. The 'average ranking' column shows the average of all positions one project had in the lists of all users. This means that the smaller the number the more often this project was on the top of users' lists.

Figure 6.6 Communication interface: Output interface

From the output interface each project has two links: the yellow one from the project name goes to the information about this project - the information interface; the red one leads to the transparency interface.

The Information interface shows information about the project to the user. The example of information for the project 'Transrapid station' is shown in Figure 6.7 at the next page. The design of this interface was influenced by the findings from the case study of the Masterplan Zuidas. The case showed that although designers believe that visualization of urban plans in the form of maps, plans, 2D or 3D drawings, computer animation etc. has a big advantage over textual presentation, our survey showed that both kinds of information are equally important to citizens. Therefore, for the Delta•M system information interface we have chosen to use both kinds of presentations, giving just slight priority to visual information.

Bearing in mind the findings about information overload and that the average time a visitor spends on a website is no longer than a few minutes, we decided to rank the information hierarchically, going from short and illustrative to long and descriptive. The user is first shown a matrix with sixteen small images, the title of the project, the name of the author and the 'more info' link. Behind each of the sixteen images, just by dragging the mouse over them, a very short text appears. Behind the title of the project is a new window with a short summary of that project. By clicking on a small image, a bigger image and more text about the same topic appear, opening the next page in the

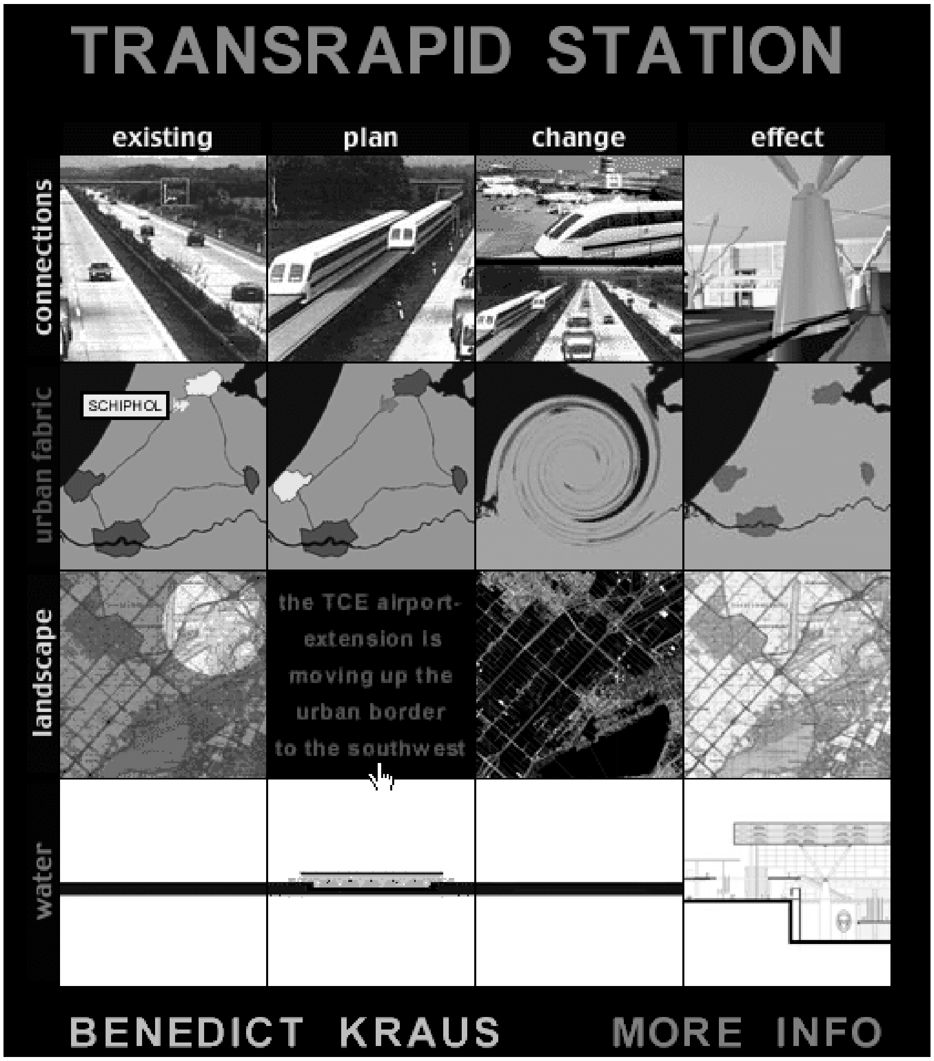


Figure 6.7 Information interface of the Delta•M prototype: Matrix with 16 images

browser. For those who want to know about the project in full detail the link 'more info' leads to the complete text about the project. The link behind the author's name is to his/her home page, and it is meant to offer even more information about the project and the author's other works.

In the design of the information interface we used the principle of ordering of information in the same way for all projects. On the one hand this is done to ensure that each project will correspond to the same aspects of the spatial design approach of the Deltametropolis studio, described as a case study in Chapter 4.5. On the other, this is also a way of making projects comparable.

Within the studio we started from the proposition that the Deltametropolis area is a synergy between four systems: urban, connections, landscape and water. This approach to understanding space was followed in the design of the matrix for presenting information about the projects. The rows in the matrix describe the four systems - connections, urban, landscape and water. The columns contain information on the time dimension and the consequences of the proposed spatial interventions:

existing – shows the existing situation in this place and in this system at the moment the intervention occurs; plan - what the project proposes for the future; change - what is going to change following this intervention; and effect - what effect the proposed change will have on the system.

The design of the user interface for information on projects has not been founded on traditional thinking about the usability of web sites. The reason for this is that we believe that the attractiveness of a website can stimulate citizens' participation in decision making. Making a website atypical, we believe, can attract the attention of citizens and stimulate not only their interest in the information, but also their will to participate in decision-making processes[3].

Although as a designer I have a preference for visual information, I can say that the interface with a lot of images also has some disadvantages. These are mostly related to the speed of loading of the images. For cable-connected computers loading would not be a problem, but for old, slow, modem-connected home computers it is indeed much more time consuming to work with images. As different people have computers with different speeds and Internet connections of various types (also influencing the speed), it is very difficult to define the optimal speed of animations. On new, cable-connected computers a GIF animation, for instance, will run too fast while on the old, modem connected computers, it will run too slow. While this may seem to be merely a technical problem, it has a big influence on how a user will experience the system and whether he/she would use it. Despite this I have to admit that I have not found an ideal solution for these kinds of problems.

The interface for the transparency of the system practically reveals the part of the system's back office to the user so that he/she can get an insight into the criteria that were used for the classification of projects. These criteria are expressed through a description of projects according to classes, objects and properties. The user can look at the scores of projects with those criteria (see Table 6.2 from the next page) and compare them with the preferences he/she expressed in answering the seven questions. The idea of letting users see this part of the system's back office is to help them understand the logic the system uses to calculate results. By understanding the logic we hope to prevent distrust in the system and to avoid the feeling that the result came from a 'black box'. As we are developing the first prototype, the reaction of users to this part of the system can be very useful for the further improvement of the system.

[3] We can distinguish here a serious decision-maker, whose professional task is to take part fully in the process, from an arbitrary visitor of the web site. The former is supposed to have sufficient patience and to retrieve all information in whatever form it is presented. The second one, a chance visitor, though, will stay at the site only if she/he is attracted by either the content or presentation of the site. Nevertheless, the problem of low participation often occurs in open Internet discussions about spatial planning. Even in professional circles, participants in a decision-making process tend to skip some sessions, mostly when they are faced with user-unfriendly computer systems.

```
Here you can find all the scores of the project Layered Land

All scores on objects are listed per class with the scores on each property per
object,
Per class below that.

Sources of objects and properties of class activity
 Objects:      care              50
               work              50
               learning          0
               sport             0
------------------------------------------------------------------------
 Properties:       care          house                      100
                                 hotels                      0
                                 apartments                  0
                                 restaurants                 0
                                 shops                       0
                                 hospitals                   0
                   ----------------------------------------------
                   work          offices                     100
                                 industry                    0
                                 farms                       0
                   ----------------------------------------------
                   learning      kindergarten                0
                                 schools                     0
                                 universities                0
                                 theatres                    0
                                 cinemas                     0
                                 museums                     0
                                 libraries                   0
                   ----------------------------------------------
                   sport         sport centers               0
                                 recreational areas          0
                                 swimming pools              0
                                 centerparks                 0
                                 amusement parks             0
                   ----------------------------------------------
Scores on objects and properties of class land use system
 Objects:      water             0
               urban             80
               landscape         0
               connections       20
------------------------------------------------------------------------
 Properties:       water         river/canal                 0
                                 see                         0
                                 lake                        0
                   ----------------------------------------------
                   urban         houses                      20
                                 offices                     60
                                 services                    0
                                 schools                     0
                                 culture                     0
                                 sport centers               0
                                 fair                        0
```

```
                                hotels                      0
                                stations                    0
                   ---------------------------------------------
                   landscape    parks                       0
                                forests                     0
                                agriculture                 0
                                farms                       0
                                dunes                       0
                                dykes                       0
                                nature areas                0
                                recreation in rural area    0
                   ---------------------------------------------
                   connections  roads                       0
                                railways                    50
                                stations                    50
                                airports                    0
                                seaports                    0
                                tunnels                     0
                                tram/light rail             0
                                river ports                 0
                   ---------------------------------------------
Scores on objects and properties of class location of a building
 Objects:     in a big city     100
              in a town         0
              in a village      0
              in a rural area   0
-----------------------------------------------------------------------
Properties:        in a big city
                   ---------------
                   in a town
                   ---------------
                   in a village
                   ---------------
                   in a rural area
                   ---------------
Scores on objects and properties of class greenery
 Objects:     in my direct surrounding <100m   0
              in the neighbourhood <500m        0
              not too far away <100m           0
              not important                    0
-----------------------------------------------------------------------
Properties:        in my direct surrounding <100m
                   ------------------------------
                   in the neighbourhood <500m
                   ------------------------------
                   not too far away <100m
                   ------------------------------
                   not important
                   ------------------------------
Scores on objects and properties of class water
 Objects:     I like water in my direct surrounding <100m              0
              water doesn’t have to be directly in my surroundings, but
              within 1000m                                              0
              not important                                             100
-----------------------------------------------------------------------
 Properties:  I like water in my direct surrounding <100m
              -------------------------------------------
              water doesn’t have to be directly in my surroundings, but
              within 1000m
              -------------------------------------------
```

```
          not important
          -----------------------------------------
Scores on objects and properties of class Accessibility
 Objects:     by car                50
              by public transport   50
              not important         0
 -----------------------------------------------------------------
 Properties:  by car
             --------------------
              by public transport
             --------------------
              not important
             --------------------
```

Table 6.2 The transparency interface: a view of the part of the back office with scores on projects

The matching system

The matching system of the Delta•M DSS prototype is slightly different to that explained in the conceptual model of the complete Delta•M DSS, as it works only with projects. It uses a specially developed algorithm to calculate to what extent the user's preferences correspond to the characteristics of the projects from the database.

Although the matching system of the Delta•M conceptual model is represented as a separate part of the DSS, in the Delta•M prototype it is actually incorporated within the database.

The database of the Delta•M is relational. To present the matching concepts, we will use the Entity-Relational (ER) model, which is a popular high-level conceptual data model. Figure 6.8 (at the next page) shows the ER model of the Delta•M prototype.

The upper left side of the scheme represents the user who has certain preferences regarding classes and In the database, the projects are described by classes, objects and properties, which are given scores (see Table 6.2). At the moment the matching system uses scores of classes and objects to calculate the result. Properties are not yet used for calculation, while in the ER model their purpose would be to refine the result of matching. Figure 6.9 (at the next page) shows the classes and objects of the projects database. This is at the same time the ER model of the database of projects, which shows the entities, attributes and relationships within the database.

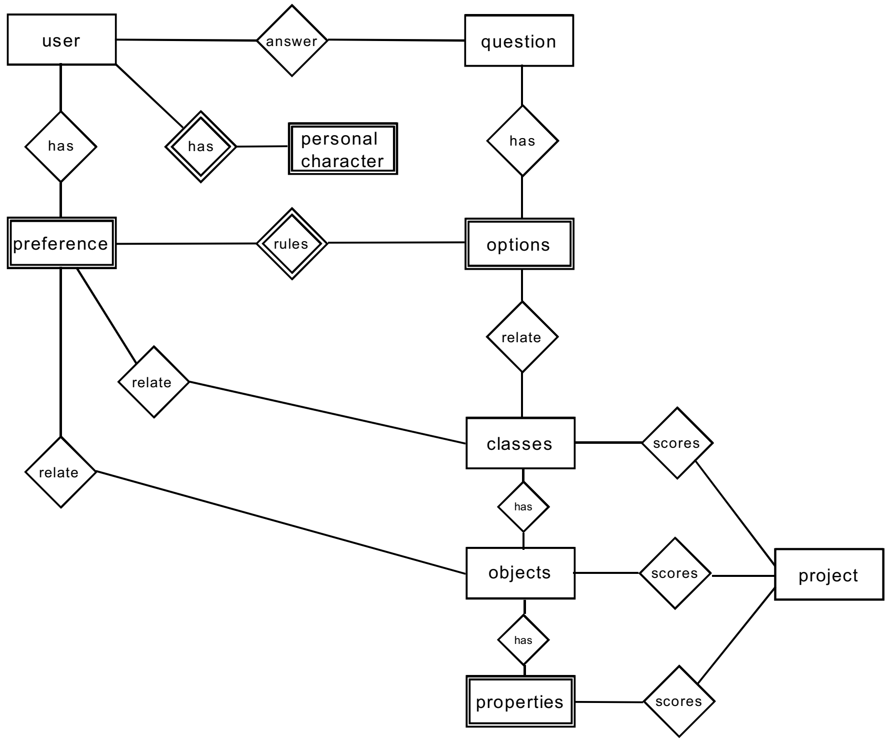


Figure 6.8 ER model of the Delta•M prototype

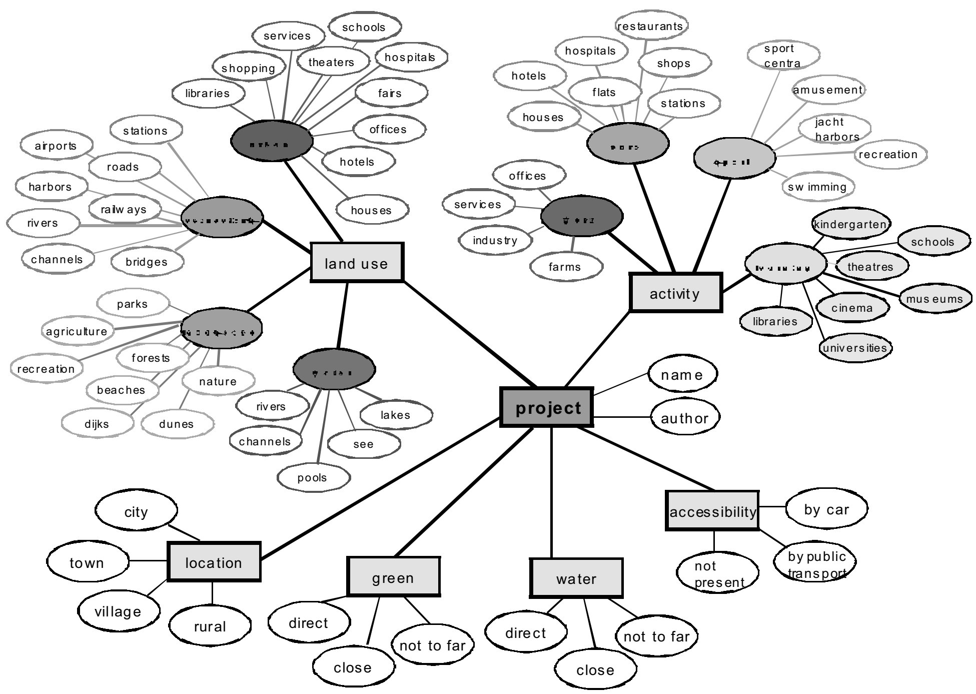


Figure 6.9 ER model of the database of projects. The classes (entities) land use, activity, location and the lake are subdivided into objects (attributes) and properties

6.2.2 Database development

The database of Delta•M is developed through several design phases: data requirements analysis, design, functional requirements definition, logical design and physical design.

Data requirements analysis

The data requirements analysis assumes the precise definition and specification of the data that will be put into the database. In the case of Delta•M the type and form of the data about the projects was defined on the basis of expert knowledge and the Deltametropolis case study. For the classification of the projects, a suitable combination of map legends that are usually applied to describe spatial perspectives is translated into the entities and attributes of the database (see Tables 6.1 and 6.2).

The definition of the questions and options was based on the empirical studies of citizens' opinions about their environment (Ruimtelijke verkenningen, 1997; see Tables 5.1, 5.2 and 5.3) and the observations made during the HMD and Zuidas Amsterdam case studies. The list of questions and options was developed in several steps. The first list that contained 44 questions was submitted for the judgment of five experts: Prof. Ir. D.H. Frieling, Prof. Dr. Ir. T.J.M. de Jong, Prof. Dr. Ir. F. Lootsma, Dr. Ir. W. Reh and Ir. J. Brouwer. The questions were divided into three groups: the personal data of users; spatial preferences; and values.

On the basis of the expert judgment, only the questions that were judged by more than three experts to be 'good questions'[4] were selected for the first trial of the Delta•M prototype. These are the seven questions presented in Table 6.1. Due to time limitations we were not able to incorporate the personal data of users into this version of the system, although it is a simple technical procedure. Therefore we left this data out completely, leaving only questions about users' spatial preferences and values in the system.

[4] The possibilities with the three level scale were: a good question; not so good but can stay; not a good question

Once we had defined the type of data we had to concentrate on the form. The majority of data in the Delta•M database is represented with images - drawings, photos and animations. The rest of the information is represented by texts.

The design of the Delta•M database

The conceptual schema of the database is a concise description of the data requirements of the users and includes detailed descriptions of the utility types, relationships, and constraints; these are expressed by using the concepts provided by the high-level data model. The design of the Delta•M database is shown in Figure 6.8.

Functional requirements definition

In this phase decisions were made about which operations and transactions would be applied to the database, including matching, retrievals, manipulation and updates.

Logical design

Logical design or data model mapping is the phase when implementation of the database using a commercial database management system (DBMS) occurs. In the case of Delta•M the CoolFusion relational DBMS is used to transform the model into the implementation data model. This part of the system is developed in cooperation with the 'Waterproof' office.

The most important part of the logical design was to discover an algorithm to reliably calculate matches between the options of the questions the user chooses and the scores of projects on classes and objects. Examples of calculations for the projects 'Layered Land' and 'Transrapid Station' are shown in Table 1 on the Appendix.

The physical design phase

In this phase the access paths for internal storage structures and the file organizations for the database files are specified. Application programs and user interfaces are designed in parallel so that the real use of the database can begin.

The Delta•M database has two application programs: an application for the input of project information, and an application for the maintenance of the back office.

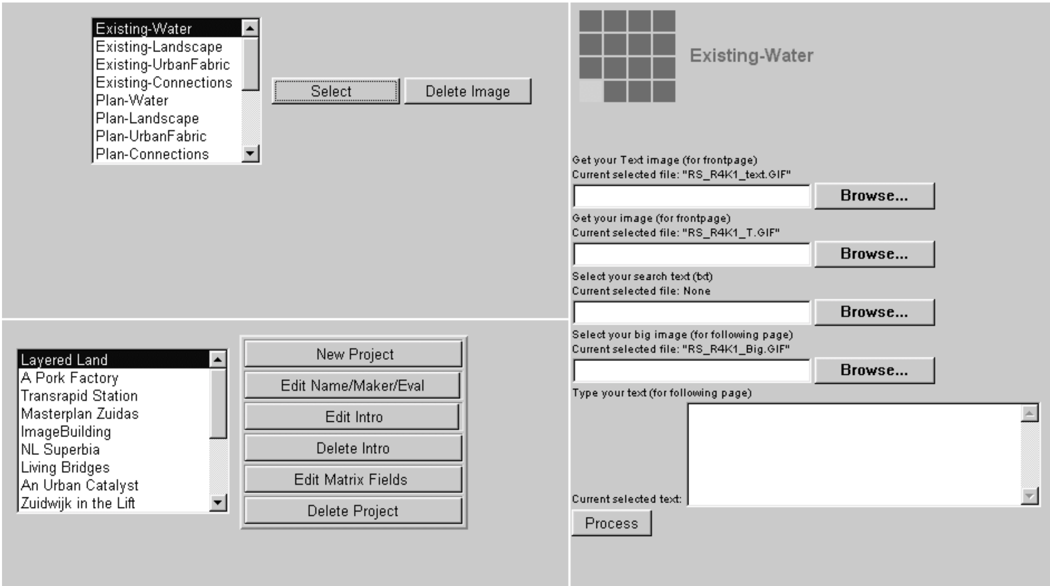


Figure 6.10 The application program for the input of project information. The window on the upper left corner shows the field in the matrix, which is also displayed in the green image of the matrix on the right-hand side - below the matrix on the right-hand side are the fields for the input of small and large images, keywords and text. In the lower left part is the menu for making new projects or deleting existing ones.

The application program for the input of project information is shown in Figure 6.10. The system administrator uses this application to input the project title, author, summary, keywords and links to the database. This data is displayed to the user via the matrix shown in Figure 6.7. The data is in the form of images and text and must be readable by html browsers (.gif, .jpg and .html). In addition to the possibility of adding new data, this application program allows the manipulation of existing data such as changing and updating.

The second application program of the Delta•M database is the system for the maintenance of the back office, already described in section 6.2.1 and presented in Table 6.1.

6.2.3 Behavior of the Delta•M prototype

The previous chapters described the form, performance and data model of the Delta•M system. The behavior of the Delta•M system should explain what the system *does*. The behavior of the Delta•M prototype is shown in Figure 6.11 at the next page.

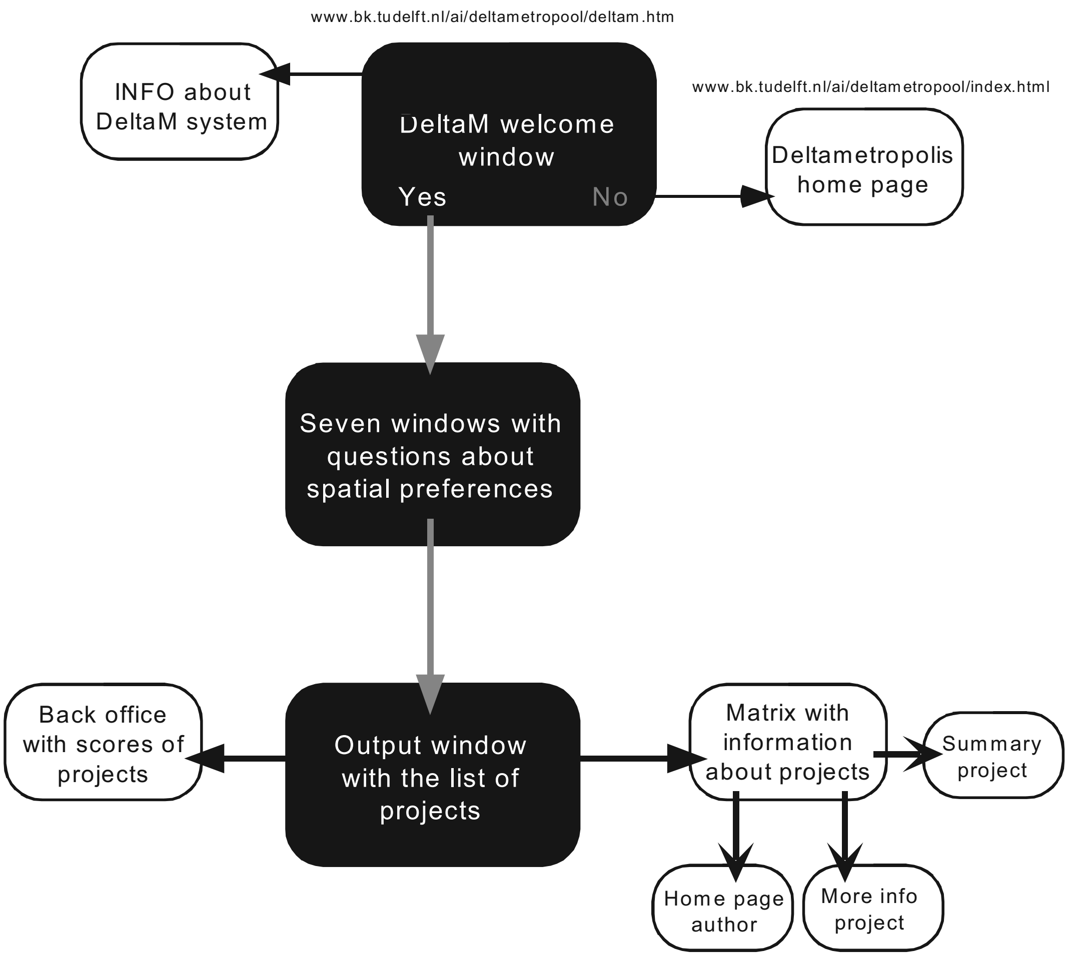


Figure 6.11 Behavior of the Delta•M prototype

On entering the Delta•M web site http://www.bk.tudelft.nl/ai/deltametropool/DeltaM.htm the user is asked whether he/she would like to use the system or not. If the answer is no he/she is connected to the database of projects where he/she can browse freely. If the answer is yes, the system starts by asking a set of seven questions.

When the last question has been answered it takes about one minute before the result is displayed: a list of projects from the database (Figure 6.6), which correspond best with the preferences of the user. From the list there are two links: the red one is to the 'back office' of the system showing the scores of the project and the yellow one is to the information about the project.

6.3 Testing and evaluation of the Delta•M DSS prototype

In Chapter 5 we described the Delta•M DSS as a conceptual model. In this chapter we presented the prototype, by explaining its form, behavior, performance and data model. We have also presented the prototyping method we used for the Delta•M development. From there it was clear that we have built a working prototype, which allowed us to set up the experiment and test and evaluate it.

Evaluation of a DSS is essential for making improvements and generating standard practices for future projects, but according to Ahtuv, Even-Tsur and Sadan (1986), it is probably the most neglected activity of the DSS development cycle. In a study carried out by

Hirschheim (1985), 20 individuals in eight organizations who had recently implemented a new MIS (management information system) were interviewed. It was found that most organizations did not carry out any formal post-implementation evaluation of their systems. Their most frequently cited reason was that such evaluations are time-consuming and require substantial resources. Most of the time evaluation of the systems only occurs when there is a high degree of dissatisfaction with the system.

In the case of the Delta•M DSS prototype, the testing and evaluation was done with no financial resources and only my own labour; therefore are should be aware of the limitations on the testing.

6.3.1 Definitions

There is some confusion about the terms evaluation and testing, because most of the time the difference is not very clear, and the meanings overlap.

According to Webster's New World dictionary, to evaluate means to judge or determine the worth and quality of something. The same dictionary defines a test as an examination, experiment or trial, so as to prove the value or ascertain the nature of something.
In the literature on evaluation and testing of computational tools these two terms are also not clearly distinguished. Evaluation is often used as an flexible word that covers judgments of many kinds. The most used definition is: *Evaluation is the systematic assessment of the worth or merit of some object*[5]. It implies that someone is examining and weighing a phenomenon against some explicit or implicit yardstick (Weiss, 1972).

According to Trochim (1999), this definition is not perfect because there are many types of evaluation that do not necessarily result in an assessment of worth or merit. Trochim cites as examples descriptive studies, implementation analyses, and formative evaluations, suggesting a definition which emphasizes the information-processing and feedback functions of evaluation: *Evaluation is the systematic acquisition and assessment of information to provide useful feedback about some object. (*http://trochim.human.cornell.edu/kb/interval.htm).
Adelman (1997) defines testing as the measurement process of assessing the status of the system against verification, validation, usability and performance criteria. Other authors would agree that testing is what Adelman says, but would chose some other criteria. Hoang (1995), for instance, tests his methodology for participatory design on the basis of five criteria: validity, effectiveness, efficiency, reliability and robustness.

In the case of the testing and evaluation of the Delta•M prototype and the conceptual model we assumed that testing tends more towards technical and usability aspects of the prototype performance while evaluation relates to the higher-level concepts and social aspects of the system, and therefore is more related to the judgment of the conceptual model of the Delta•M DSS. Nevertheless, we will often use the term evaluation in judging the value of the prototype Delta•M, as we assume that the prototype has values that are of a abstract nature too.

6.3.2 Testing methodology

The purpose of examining the Delta•M prototype is to indicate user satisfaction with the system and to find out whether it is complete enough to be implemented in practice. The development of our own testing methodology is based on the research of Adelman et al (1982), who have pointed out that the DSS development process needs to be monitored from the perspective of three interfaces:

- the extent to which the system fits the characteristics of the individuals who are going to use it,
- the structure and the processes of the organization to which it will reside, and
- the demands of the problem environment affecting the organization's performance.

[5] Object could refer to a person (evaluating a worker's job performance), a thing (new building), an idea (movie script) or a program (housing, mental health, legal services), a policy, technology, need, activity, and so on (http://trochim.human.cornell.edu/kb/interval.htm).

Based on Adelman's approach we developed further the methods for the three-level evaluation of the Delta•M prototype. Each of the levels should be evaluated with different methods and different criteria.

First, the DSS has to be verified by checking whether it is technically well built (a technical evaluation). Then the user's appreciation of the DSS has to be evaluated by employing methods of subjective evaluation. In this particular case we applied the criteria for the measurement of the usability of websites. The content of the system – its suitability for the user and the organization that has built it – will be evaluated by using an empirical evaluation. These three evaluations could be also designated as 'testing' of the system in the framework of Adelman and Riedel's (1997) definition. Evaluation of the fourth interface – the relationship of the system, its users and its organization with society – then falls under the term that Adelman and Riedel call 'evaluation', which is 'putting all the test results together in order to make an overall assessment of the value of the system'. Figure 6.12 shows the four steps that are to be used for the evaluation of the Delta•M system.

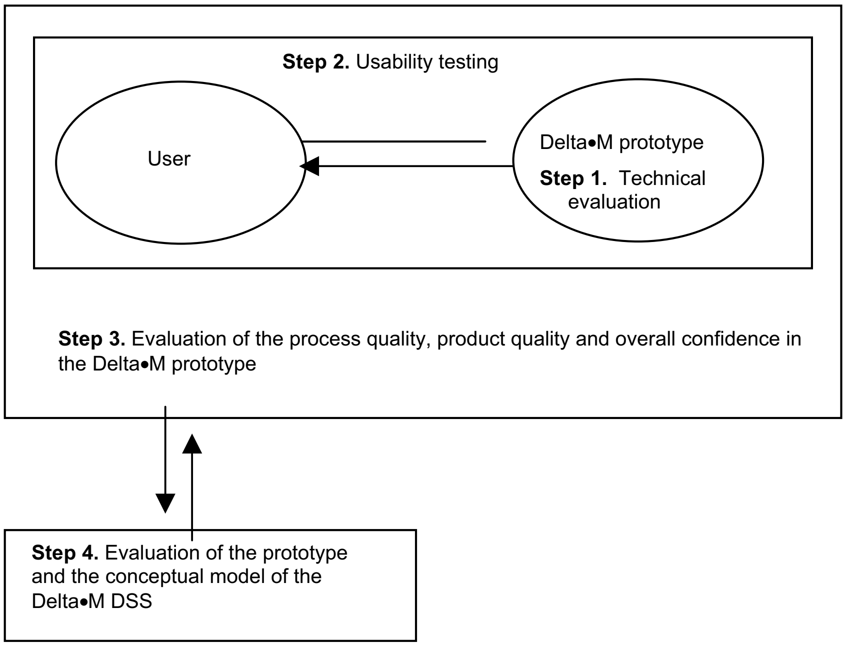


Figure 6.12 Four-step methodology for testing and evaluating the Delta•M DSS

Technical evaluation

Technical evaluation focuses on how well the DSS was built. We tested the Delta•M prototype simultaneously with its development. The part of the physical development of the system (programming the information-input application, back office and the matching system) was delegated to a commercial office Waterproof. In the course of several meetings at which the assignment was discussed we had to check wether the office properly understood the assignment and the specifications of the system. Then the components of the system were developed: first the information input application, then the back office and the matching system. As the components were developed the testing started and continued until the whole prototype was put together and connected with the user interfaces. This lasted about six months.

The criteria for the technical evaluation of the Delta•M prototype are reliability, validity, effectiveness, efficiency, and robustness. Below we will explain what each of the terms means. Then in *italics* we will present the results of the testing of the Delta•M prototype.

Reliability: means demonstrating that the operations of the tool can be repeated with the same results (Adelman, 1992).
After repeatedly testing the system performance it was concluded that Delta•M was reliable. The same set of answers will always lead to the same list of projects.

Validity: According to Webster's dictionary, validity is demonstrated if the system is well-grounded on principles of evidence.
The validity of the Delta•M system is obtained through its transparency. This is a fact because the background knowledge, the principles and the model of the tool are made visible to the user.

In evaluating his dialogical model for participatory design, Hoang (1995) states that validity means that the tool should be able to achieve its functions.

In the numerous examples of its use, Delta•M has shown that it is able to function with no bugs, crashes or other problems that can disturb the proper function of a computer system.

Effectiveness: The tool should be able to support its users in achieving their goals (Hoang, 1995).

In contrast to the usual information-retrieving methods (such as browsing through web pages or database search queries) which often end up with no results or information overload, Delta•M's goal to quickly and securely select projects (from among 17 in the case of the prototype, in the real situation there would be many more) is achieved.

Efficiency: The resources needed to achieve the goal by using the tool should be minimal. If use of the tool saves time, manpower and equipment, operation is easy in comparison to existing methods, and efficiency is high.

From the table 6.3(below) we can see that Delta•M is very efficient because it requires minimal investments to be adjusted to any planning situation.

Robustness: That the tool should lead to new development.

Delta•M is flexible so as to be able to be adjusted to future technologies and compatible with other tools such as communication, design or interaction tools.

Delta•M	**to set it up**	**to use it**
Budget	Dfl. 40,000 for the initial Prototype	no
Time	6 months for the prototype, A few days for follow-up uses	3 minutes to 1 hour
Manpower	two people	no
Equipment	PC/Internet	PC/Internet

Table 6.3 Efficiency of the prototype of the Delta•M DSS

Usability testing

Usability addresses the question of how much the users like the system. Probably the most widely used indicator of DSS effectiveness has been user satisfaction. According to Adler and Winograd (1992), who put the emphasis on the 'communicativeness' of systems, the key criterion of a system's usability is the extent to which it supports the potential for people who work with it to understand it, to learn, and to make changes. For Adelman and Riedel (1997), usability is inseparable from the interface design; these two have to be considered from the beginning of the system development process. This is because 'to many users, the system is its interface. If the interface is hard to use, then they will conclude that the system is hard to use' (Adelman and Riedel, 1997).

For the measurement of usability we have developed criteria that are a combination of usability testing of websites and usability of computer applications in general. These are: General ease of use, consistency, attractiveness, control, efficiency, and learnability.

General ease of use means that the system is easy to use and understand.

Consistency implies that the system is consequent in the layout of the screens and in presentation of information; that the same commands produce the same actions throughout the system and that all parts of the system are clearly labeled.

Attractiveness tackles the degree to which users like the site, whether they find it pleasant to use.

Control shows the degree to which users feel 'in charge', whether the site allows them to navigate through it with ease.

Efficiency is the degree to which users feel that the site has the information they are looking for, that it works at a reasonable speed and is adapted to their browser.

Learnability is the degree to which users feel they can get to use the site if they come into it for the first time, and the degree to which they feel they can learn to use other facilities or access other information once they have started using it.

The criteria explained above were translated into the 20 questions presented in Appendix Table 2, which were used to interview the users.

Empirical evaluation

Empirical evaluation focuses on a decision-maker's performance with (versus without) the system. The reason for the empirical evaluation is that even when the system is technically good and users like it, they might not use it. The reason for that may lie in the inadequacy of the content of the system's knowledge base. The criteria for the empirical evaluation are: *process quality, product quality and overall confidence in the system*. These criteria were translated into questions 21 to 39 presented in Appendix Table 2.

6.3.3 Results of the usability testing and empirical evaluation

Usability testing and empirical evaluation of the prototype Delta•M was conducted among randomly chosen inhabitants of virtual space – the people I could access via e-mail. I contacted about 500 people – professionals, friends, students and members of Plannet and PSS discussion lists, mostly from the Netherlands, Europe and the United States. The response was very low as only 26 people evaluated the tool within the two months of available time.

Of the 26, 13 were men and 13 were women; 22 were experienced Internet users and four use the Internet only occasionally. The age of most of them was between 30 and 50. By profession there were several designers, architects, researchers, students, and a secretary, a photographer, a lawyer, and a psychologist.

Asked about their role in physical planning, most of them opted for multiple roles, almost all of them being inhabitants and citizens of the country (not Americans and Australians), five of them are members of a social group, and one is a landowner. There were no public authorities or investors in the group that responded to the invitation to evaluate the Delta· •M system.

Results of usability testing

Tables 3, 4, and 5 and Graph 1 (Appendix) present the results of usability testing. In the text we will make assumptions per criteria. Detailed results for each question can be seen in the tables and the graph.

General ease of use: The opinion about general ease of use expressed through the first four questions was very positive for all the questions.

Consistency: consistency of the layout, information presentation, commands and labeling of the website was very positively experienced. Users were less positive about the attractiveness of the website, though most of them enjoyed the experience of using the site.

Control: For most of the users, going from one part of the website to another was not a problem, but almost half felt that they were not completely in control of the website.

Efficiency: Although a lot of people neither agreed nor disagreed with the statement in the question, most of the respondents agreed that choosing projects using Delta•M is faster than with current procedures. Four of them explained that they were not sufficiently informed about the current procedures, and so were unable to make a comparison (see Table 4). Similar reasons can be found for the insecurity about the easiness of choosing projects (Question 14). Most of the respondents were not sure if the list of projects met their needs. This is a big question mark and discussion point, because the database contains only 15 projects, most of them are related to urban systems and connections, and only five projects are fully represented with all information needed for the presentation of the project in the Delta•M way.

Nevertheless, most of the respondents were positive about using Delta•M under time pressure and its response was fast enough to keep them interested in using the system.

Learnability: Most of the people agree that no training is required to use Delta•M for infrequent users and that the material is presented in a way that is easy to understand. There are a reasonable number of help features, but some of the respondents had difficulties here. Here I would agree with Alinta Thornton from Australia (who was otherwise very negative) that if the system is good then no help features are needed.

The results of empirical evaluation

The results of the empirical evaluation are also shown in Appendix, Tables 3, 4 and 5 and Graph 1. Empirical evaluation is dealt with in questions 21 to 39.

Process quality: The process quality of the Delta•M system was judged by answering questions 21 to 30. Here we can see that many doubts were cast on the choice of questions and the scoring system for classification of the projects. Most of the respondents did not have enough data to decide whether they liked a given project or not. However, they were much more positive about the rightness of data that Delta•M uses to inform users about projects, the visual presentation of the data and the terminology, which was familiar for most of them. The matrix for the presentation of projects was very positively received. The logic of the system was not so clear to the users but they still felt that Delta•M contains an adequate level of expertise to support users in choosing projects, although they are not so positive about the possibility the system gives users to examine this expertise.

Product quality: was judged by questions 31 to 35. For most of the respondents it was easy to interpret the results of Delta•M and to form a mental picture of how the system works, and the system's way of reasoning was acceptable. There were, however, many doubts about the usefulness of the output results. As it is possible to see from the comments (Table 5, and some separate e-mails and discussions with users) that here again we come across problems because of the incompleteness of the database of projects.

Overall confidence: Questions 36 to 39 were devoted to the judgement of the overall system's confidence. Most of the respondents were very positive in this respect. The results obtained by working with Delta•M, its technical soundness and the approach Delta•M uses in its quick selection of plans were positively judged. Six of the 26 people were influenced by the statistics shown next to the answers, while most of the others were only slightly or not at all influenced by this.

6.4 Conclusions

This chapter presents the prototype of the Delta•M DSS, which is only a part of the conceptual model of the complete DSS. We have explained the prototyping method, the steps, the form, the content and the behavior of the prototype.

As was expected at the beginning of the prototype development, its physical realization and the opportunity to test it with users brought us valuable knowledge which can be used either in the further development of the Delta•M system or for the design of a new spatial DSS.

For the testing and evaluation of the prototype of the Delta•M DSS a special methodology was developed. First it was technically tested, and when approved, it was engaged in the usability testing and empirical evaluation.

The aim of the testing was to find out how users react to the system, whether it is satisfactory, what are the good and weak points of the prototype, and finally whether the system is complete enough to be implemented in practice.

The results of the technical testing have shown that the system is good enough to be implemented. The experience during experimental use over a year have confirmed that it is technically very reliable, valid, effective efficient and robust.

The results of usability testing have shown that the general ease of use, consistency, control and learnability of the system are good. Most of the problems and users' criticisms concerned certain aspects of the efficiency criteria. These related to the amount of information about the projects, and the quality and variety of projects. Here we can for the most part 'blame' the deficiency of the database of projects, which indeed contained only 15 projects, only five of them being fully provided with information. I say for the most part because I warned evaluators about this and suggested to them which projects to look at for judging the presentation of information. Also, some people were very critical about the lack of 'landscape' and 'water' projects.

As we are not completely sure about the reason for the low scores in evaluation of this part of the system we will have to repeat the testing once the database of projects is updated with a larger amount of projects of different kinds.

Similar conclusions can be drawn for the part of the empirical evaluation which concerned product quality. Many of the respondents had doubts about the usefulness of the output results (in this case the list of projects). The evaluation of the process quality confirmed the fears we had when setting up the questions about user preferences and the criteria for the classification of projects. These are conceptually the most difficult parts of the whole system and also very important parts. The evaluation has shown that here a lot of further exploration has to be done. Luckily, Delta•M is technically built in a very flexible way, so the questions and criteria can be easily changed, which is a great opportunity for many experiments that can take place in the future. However, looking at the opinions of users about overall confidence in the system we can be very satisfied and conclude that generally people reacted positively to the Delta•M prototype.

In the form it is in now, the Delta•M prototype needs several adjustments to be directly implemented in practice. Expanding the database with new projects and making information about all the projects complete is the first step to be made, and is in fact a step of a technical nature. It is a question of whether we would decide to continue to develop the database with the projects of students or decide to work with 'real' projects, those that are officially approved. Whatever decision might be made, it is not a question of availability of projects – there are many on both sides, and organizations such as New Map of the Netherlands are already engaging in the inventarization of projects on the national level. The other step is to adjust the questions on user preferences and criteria for the classification of projects so that the process quality evaluation improves. This step is a much more theoretical one and requires more exploration in the future.

The last step in this research concerns the evaluation of the prototype and the complete Delta•M DSS. After the evaluation the final conclusions about the applicability of the Delta•M DSS will be drawn. The next two chapters are devoted to the evaluation of the Delta•M DSS.

Part five –

Evaluation

Chapter 7. Evaluation of the Delta•M DSS and possibilities for its implementation

In this chapter we will reflect on the specific tool requirements in order to evaluate the response of the Delta•M DSS to the theoretical and empirical framework of this research.

We will then discuss the possible use of the Delta•M DSS in spatial decision making. First we will look at the possibilities for direct implementation of the prototype of the Delta•M DSS in procedures of spatial decision making currently being used. Then we will consider the implementation possibilities of the complete Delta•M system.

7.1 Evaluation of the Delta•M DSS in relation to the specific system requirements

The specific tool requirements have already been presented in the conclusions of Chapters 2, 3 and 4. But for the sake of the transparency of this evaluation, we will list them once again, marking them with numbers, so that later we can refer to them easily. The number of stars after each of the requirements indicates whether it is represented in more than one part of the Delta•M DSS.

The requirements for the Delta•M DSS related to pluricentric decision making are that it should:

1. Be available to all the actors in the decision-making process.∗∗∗
2. Provide interaction between central and decentral actors.∗
3. Provide a platform where actors can negotiate a common interest.∗
4. Provide the tools for actors to be able to exchange knowledge, negotiate about investments, and determine responsibilities.∗
5. Provide a platform for decision making about specific issues in series.∗∗
6. Be designed to give actors policy freedom and autonomy.∗

The requirements for the Delta•M DSS related to neo-republican citizenship are that is should:

7. Be open to every citizen.∗∗∗
8. Be free for individuals to form communities and organize plurality.∗
9. Provide a platform for the debate of neo-republican citizens.∗
10. Provide a platform for the exercise of individual competence.∗∗
11. Provide access to a position of political equality for all citizens involved.∗∗
12. Enable exercise of the office of citizenship.∗∗
13. Enable supervision of the office by other-co-citizens.∗∗

The requirements for the Delta•M DSS related to the public sphere are that it should:

14. Provide a dialog which occurs outside the realm of government.∗
15. Provide an environment for the formation of public opinion.∗
16. Provide access to the public sphere to all citizens.∗∗
17. Provide environment where citizens would be able to express their opinion freely.∗∗∗
18. Provide a discursive arena that is home to citizen debate, deliberation, agreement, and action.∗

The requirements for the Delta•M DSS related to electronic democracy are that it should:

19. Be available via the World Wide Web.∗∗∗
20. Give the same opportunity for participation to all social groups.∗∗∗
21. Provide users' interaction on an equal level.∗∗∗
22. Respect the rights of individuals and strengthen the community.
23. Create new information and communication channels between citizens and decision-makers.∗
24. Increase political participation.∗∗∗
25. Help break established societal hierarchies and bureaucracy. ∗∗
26. Stimulate interaction between citizens and their democratic representatives and thus maintain the stability of the state apparatus. ∗

27. Support modified representative democracy. ∗

Requirements based on the analysis of existing DSSs are that the Delta•M DSS should:

28. Help users to select alternative solutions following principles of rational decision making so as to improve the structure of decision-making processes. But Delta•M should also be sensitive to the needs of the decision-maker and provide assistance based on his cognitive style and personal characteristics.∗
29. Employ a computer-based 'agent' to prevent users' cognitive overload.∗
    The agent should follow users' preferences and select information on the basis of this.
30. Be able to capture the complexity and dynamic character of spatial planning processes. ∗∗
31. Have a flexible structure so that it is applicable to different planning situations. ∗∗∗
32. Be user friendly, well integrated, and function as a whole.∗
    The design of user interfaces is extremely important for user friendliness, as most users associate the interface with the system itself.
    In the Delta•M DSS, user interfaces should establish common ground between the user and the computer, similar to those that people use in human-to-human conversation.
    The reasoning logic of the system should be displayed to the user so as to improve the transparency of the system and to make it more trustworthy.
33. Be implemented via the WWW and tested for its usability.∗
    A testing methodology for WWW-based DSSs should be developed.
34. Combine GISs with other, more intelligent technologies. Integration of models and the requisite modeling technology in a knowledge base of the system is needed for reliable results and the proper functioning of the system.∗

Requirements based on the case study of HMD:
A. The five essential characteristics of the HMD method which are used in the Delta•M DSS development:

35. Differentiation of the scale levels of plans – perspectives and projects - and their interrelationships. ∗
36. Recognition that different scale levels have different grade of influence:
    - perspectives only give direction to the spatial development ∗
    - projects are concrete spatial interventions ∗
37. Recognition that different scale levels involve different actors and different kinds of responsibilities:
    - perspectives: predominantly public (voting) ∗
    - projects: predominantly private (investments)∗
38. Differentiation of three phases in decision making:
    1. Individual opinion forming (study room) ∗
    2. Negotiations (dealing room) ∗
    3. Evaluation (parliament)
39. Recognition of the necessity to choose development strategies on both the individual and collective level (strategy = perspective + projects portfolio) ∗

B. Requirements based on analysis of the implementation of DSSs in the HMD method are:

40. The Delta•M DSS should integrate different parts and different technologies in order to function as a whole.∗∗∗
41. The Delta•M DSS requires a multidisciplinary approach, including experts in spatial planning who also have experience in building decision support systems.∗
42. The concept of the Delta•M DSS should be dynamic so as to be able to respond to frequent changes and information updates.∗∗∗
43. The Delta•M DSS should use information in its full form, not simplifying data and relationships. But it should use models and agents to filter the information according to users' needs.∗∗
44. The Delta•M DSS should use advanced technologies for the visualization of spatial information so that the quality of representation and speed of the system do not come into conflict.∗∗
45. The Delta•M DSS should be carefully integrated into the decision-making process. The questions of who, when, how and in what phases of the decision-making process should be answered beforehand.

In the following text we will reflect on the parts of the Delta•M DSS for individual opinion forming, the parts of the DSS for collective decision making, and the system as a whole in order to see to what extent the requirements are incorporated in the design of the system.

The database of the Delta•M DSS contains information about spatial plans, the status of planning procedures, and users and their actions. The database captures each new input from users or organization of the process of decision making, and records data about the new users, users' comments, new plans, new status of procedures, new status of voting, etc. The database is open to use and available via the WWW.
Fulfilled requirements: 1, 7, 13, 19, 30, 31, 42, 43.

The knowledge base of the Delta•M DSS uses models to relate projects and perspectives in order to define the consequences of alternative solutions.
Fulfilled requirements: 31, 34, 35, 36, 37, 40, 41.

The matching system of the Delta•M DSS extracts information from the database according to the user's preferences, and advises the user which strategy (combination of perspective with projects portfolio) to choose.
Fulfilled requirements: 28, 29, 31, 38, 40, 43.

The user interfaces of the Delta•M DSS provide interaction between the system and the user similar to human to human communication. The result of the 'matching' process will be displayed in high quality visual form. Interfaces are available through the web browser.
Fulfilled requirements: 1, 7, 19, 32, 33, 40, 44.

Annotation tools give users' the possibility to react to projects and perspectives in the form of comments.
Fulfilled requirements: 6, 7, 10, 16, 17, 20, 21, 24, 38.

Communication tools provide interaction and negotiation between the participants in the decision-making process.
Fulfilled requirements: 2, 3, 4, 5, 8, 9, 11, 12, 14, 15, 16, 17, 18, 20, 21, 23, 24, 25, 26, 27, 38.

Communication tools which are connected to the design tools can support simultaneous negotiation and creation of new plans. These will be automatically added to the database.
Fulfilled requirements: 35, 37, 44.

The voting system of the Delta•M DSS will provide the designing system with information about the status of votes on the community level , or about the public opinion of the community.
Fulfilled requirements: 1, 5, 7, 10, 11, 12, 13, 15, 17, 20, 21, 24, 25, 30, 38, 39, 42.

As can be seen from this overview, requirement 45 is not explicitly represented in the system itself. This is because it relates to the implementation of the system in the decision-making 'organization'. This issue relates to the applicability of the Delta•M DSS and we will deal with it in the next two sections.

7.2 The applicability of the prototype part of the Delta•M DSS

To make the practical purpose of the prototype of the Delta•M DSS clear, we will try to answer the questions of who should use it, why and when. We will also discuss how the outcomes of the system should be treated and how they should combine with traditional human decision-making and negotiation processes.

The prototype part of the Delta•M system can only be used for individual opinion forming and only with regard to projects. Although there exists the possibility to add perspectives to the database, which means that perspectives would be selected in the same way as projects, the possibility to relate projects and perspectives is not yet developed in the prototype. In its current version, Delta•M can be directly used by students and staff of the Faculty of Architecture for the presentation, evaluation and judgment of graduate projects of students of the Deltametropolis studio.

The prototype can also be adjusted to any other situation when choices have to be made on an individual level between either many projects or many variants of the same project. This would be, for instance, a situation involving choosing the projects portfolio in the Metropolitan Debate (HMD) simulation, deciding on projects from the database of the New Map of the Netherlands, or preparing citizens for the use of their legal say ('*inspraak*') in any of the currently used plan-making processes. This would imply that the current database of projects will be replaced by other projects and probably a different way to represent projects would be chosen, with different questions on users' preferences. This would certainly be possible because the prototype of Delta•M is built in a flexible way: two application programs – the input of project information and the back office – allow the users of the system to change the content of the database, and to set up their own questions and criteria for the classification of projects. In addition, statistical tools that accompany the prototype, although moderate, can provide a quick insight into public opinion about the projects.

In discussing the relationship between the product of the DSS and human decision making, we argue that the output of the system – the list of projects – should be accepted as a suggestion and not a final decision. The user is given the opportunity to check, compare, and select projects independently. Hence, the combination of these two actions – computational support and human judgement – should lead to a final decision on the individual level – the establishment of the personal projects portfolio. In combination with an individual preference and choice of perspective, it provides the citizen with a personal strategy, furnishing her or him with the power of strategic action. Thus the Delta•M DSS is an instrument of citizens' empowerment. A similar process can then be used to form alliances between participants and forge common strategies.

7.3 The applicability of the Delta•M DSS as a whole

The complete Delta•M DSS will be applicable to both individual and collective phases of decision making. In this section the questions of who should use the complete Delta•M system, why and when, will be explored. We will also examine which phases of the decision-making process the system can be implemented in, and what its relationship is with human decision-making and negotiation processes.

When thinking about the ultimate application of the Delta•M system one has to imagine an ideal situation in which every citizen is given the opportunity to take part in decision making about the spatial development of an area by forming a designing system together with official public and private stakeholders. There would be no restrictions in any respect - every profession, every social group, every sex, every individual, organization and so forth can take part in the process.

There are always many plans; in almost every spatial scale in the Netherlands we can find many concurring and currently competing projects or perspectives. But space in this country is scarce and the investors are more critical than the developers of plans. Investment priorities - choices between the projects to be realized and perspectives which will give us the long-term framework for the spatial development of a certain area - have to be made. Citizens need information about the plans, they need to compare them, to weigh the alternatives, to estimate the consequences and finally to select which plans they would choose.

The problems that would be encountered here in the current situation are:

1. Citizens have no opportunity to take part directly in decision making; they can only react to plans at the 'inspraak' moments in the procedure of plan development and approval.
2. Although the situation has greatly improved in the democratization of spatial decision making in the last few years due to the growth of the Internet, there are nevertheless many practical restrictions in citizens' participation, as professionals and politicians still dominate decision-making processes.
3. The establishment of an actual, accurate, up-to-date, easily and freely accessible information system about existing spatial plans according to municipalities, provinces and the state is at the initial phase and is restricted in use.
4. There is no guarantee of whether all, the majority or a minority of citizens would be interested in participating in spatial planning processes, even when it would be legally and technically possible.
5. There is no mechanism to measure and permanently track public opinion about spatial development on the municipal, regional, provincial or national scale.

The Delta•M system could help to improve the situation in many of the aforesaid matters. The Delta•M DSS is intended to be used by a 'designing system' and can be employed at each level of spatial decision making, whether it is a matter concerning the local (local land use plan), municipal (Structure plan or Master plan), regional (Regional plan), or national level (National

Spatial Policy Document). By doing so it would make the idea of a 'designing system' realizable in practice. Instead of participation in only certain 'inspraak' moments in a decision-making procedure, citizens would be able, through interaction with other actors, to develop the spatial arrangement of a certain area from the very beginning of the process.

Concerning the matter of restrictions, the Delta•M DSS is fully open: every interested citizen would get the opportunity to take part in spatial planning and decision making and no restrictions will be placed on the system, so participation from all social groups would be on an equal basis. The intention here, however, is not to let citizens play as a loose collection of chance participants, but to enable citizens to come into the direct communication with 'real' actors in decision making – authorities and investors. On this way the Delta•M DSS would provide better interaction within the designing system and promote a moderate version of direct democracy.

If the development of a national spatial planning information system were to proceed as planned, the Delta•M DSS would add an extra element of functionality to it: the possibility for individual and collective decision making. The Delta•M system will help citizens to get information in a personalized way, to accurately and quickly make choices on an individual level and to interact with other community members in order to make choices on the collective level as well.

By collecting data about the users in the database, new knowledge will be obtained about the extent of citizens' participation and their spatial preferences. All this data is not only important for the future improvement of the Delta•M system, but also for research on the democratization of spatial decision making.

The Delta•M system is in no way intended to replace human judgement and negotiation. Quite the opposite, it is intended to facilitate these processes by providing possibilities to design more alternatives and to evaluate them, as well as to create improved conditions for forming coalitions. These are:
(1) Permanent access to information; retrieval of data and processing a large amount of information which is normally difficult to compare; (2) time and place independent communication between participants in decision making, which saves time and effort in arranging meetings; (3) meetings that will be – and need to be – arranged, because human contact is necessary in all decisions of any serious importance, will be better structured. Criteria and subjects of discussions are often ad-hoc, based on the individual and implicit approach of the participant. By introducing Delta•M the criteria and subjects can be made explicit and reproducible by others.

Whether the outcome of the Delta•M system would be considered to be a final decision or merely the start of a new debate is a question to be decided by the designing system; but in any case, the outcome can be taken as a valuable indicator of public opinion.

7.4 Conclusions

In this chapter we have looked at the relationship of the parts of the Delta•M DSS and the complete system to the specific system requirements. We have shown in which parts of the Delta•M DSS which of the requirements are represented. We can conclude that all of the requirements are represented in at least one of the system parts and some of them are represented in more that one of the system parts.

The last requirement, which concerns the applicability of the Delta•M DSS in the decision-making process and organization, was discussed separately. We have looked at the applicability of the prototype and of the complete system, if it would be developed as it is explained in the conceptual model of the Delta•M DSS proposed by this research.

We have concluded that the prototype of the Delta•M DSS can be directly used in the form as it is by the students and staff of the Faculty of Architecture of the TU Delft. With slight changes the prototype can be implemented in real planning situations, for the process of selection of projects.

The complete Delta•M DSS has much broader possibilities for implementation in spatial planning practice. If it were to be fully developed it would be able to help metropolitan designing systems in getting better information, making decisions on the individual and collective level, organizing direct participation in any kind of planning situation, and reinforcing human networks and communication.

Chapter 8. Conclusions

8.1 Concluding remarks

This research has set up the development of the Delta•M Decision Support System. The aim of the Delta•M DSS is to help the members of a designing system to make decisions about spatial plans better and faster. This will be facilitated by providing the members with the tools for individual opinion forming and collective interaction. These tools will be integrated in Delta•M as an overall useful DSS.

At several points in this text we have discussed problems that arise from procedures currently used in decision making concerning spatial plans. This research proposes ways of dealing with these problems, which in our opinion are more fitting for contemporary society. Therefore the research transposes the theoretical knowledge into a technical product – a tool – that would make the realization of the theories easier.

8.2 Reflection on assumptions

The research assumptions presented in Chapter 1.7 were examined according to the given frameworks, conceptual modeling and prototyping. We can draw some conclusions in terms of reflection on the research assumptions.

The first assumption of this research was that *the quality and speed of spatial decision making will improve by the formation of designing systems.*

For this research we have defined a *designing system* as a coalition of actors, individual or institutional, including citizens. This means that a decision about the spatial arrangement of a territory falls under collective responsibility. This also means that a *pluricentric* model of decision making has to unite interests and means, which are distributed across the autonomous actors of the designing system, so that a decision is satisfactory for all the members of the system. This all requires a high level of motivation, competence and cooperation.

This research has not gained an *exact* insight into the state of readiness of the authorities and actors to form designing systems together with citizens. But in Chapters 1, 2, 3 and 4 we have presented the movements in society and positions in scientific theories which indicate that the time to change traditional ways of dealing with spatial policy is ripe, and the 'climate' for those changes in Dutch society is good.

This research also has not gained an insight into the *exact* state of *readiness* of Dutch citizens to participate in decision making about spatial plans. The low participation in our own study and case studies of other researchers gave us an indication that there are still few citizens who are interested and willing to participate.

Participation in spatial planning in the Netherlands is currently organized mainly by way of a wide array of interest groups from employers' organizations to environmental groups. Many citizens know that they are represented by some or even several of these groups, and they have their say in these organizations. Often, when important plans are under consideration, public debates happen via the media such as TV, newspapers and in some cases the Internet. So the *indirect* democracy has a very rich texture. Nevertheless in public legal discussions about spatial plans, usually only a very small number of citizens *directly* participate. The only mass reactions are when citizens feel threatened by a new plan – a phenomenon known as 'not in my backyard'. Those who are positive about a plan would very rarely get involved, as it is quite normal not to lose time if everything is all right.

In an experimental situation, such as were the four examples of case studies of this research, there is no real urge for people to participate, and there is no direct motivation to do so. Therefore we would draw the wrong conclusions if we were to use this experience to judge the potential number of participants in a real designing system, when a concrete spatial problem is at issue.

Here the questions that arise are whether it is necessary that the majority of citizens participate, what would be the optimal number of participants, and whether participation should be left as spontaneous and arbitrary or whether some mechanisms should be devised to oblige citizens to participate.

This research proposes an open planning process where every citizen is free to participate. But we have to be aware that the success of such a process depends on the social and political climate. Before there can be full participation in democracy, individual citizens must see themselves as an important part of political life. They have to take the concept of participation in government seriously, and believe that they will provide a useful contribution to it and have a duty to make it. The involvement of neo-republican citizens in decision-making processes is therefore not a self-fulfilling act. It has to be organized, stimulated, cherished and kept in continuity. Only then we can have successful designing systems.

This research proposes several methods for improving citizens' participation. These are:

1. Raising citizens' awareness of the importance of spatial planning through education and the media.
2. Providing proper, accurate and up-to-date information about the issue under consideration through the media and the Internet.
3. Intensive 'advertising' of the planning process in the media so that every level of society certainly gets informed about it.
4. In the cases of small communities, stimulating the participation of all social groups by sending personal invitations to participate.
5. Improvement of communication methods and tools so that participants can easily understand the possibilities and options available without spending too much time.

Of course, an important precondition for each real decision to be made is not only citizens' participation, but also the willingness of public and private actors to form a coalition with citizens and establish a designing system. A core of powerful actors can in that sense stimulate citizens' participation.

When the system is open to every interested citizen it is difficult to control the quality and competence of participants in the decision-making process. We can imagine a situation in which the hard-working citizens – those who lack spare time – will be overruled by notorious troublemakers. This would lower the quality of decisions. Hence, in an open decision-making process the greatest mastery will be to provide and maintain a good level of quality and relevance of the participants throughout the whole process.

If the open process gets threatened by incompetent participants, some control mechanisms can be added later to the Delta•M DSS, such as:

1. Giving the citizens who are directly affected by a plan more formal influence than to those who are only indirectly affected (inhabitants of an area, public or private investors, landowners, etc.)
2. Using computational techniques to distinguish the influence of citizens, by introducing, for example, weighing factors on decisions of different groups (Lootsma, 2000).
3. Randomly selecting a statistically significant number of participants from the population register and inviting them to take part in decision making (a principle of the American voting system).

Looking at the practice of the implementation of electronic democracy in spatial planning, we can say that compared to the number of current procedures which use established democratic processes, these are rare occurrences, although the attention that they get in the media and academic world might give a different impression. Therefore researchers lack practical experience in large-scale participation. The question of the profile of participants and the ratio between competent and incompetent citizens is still too early to be answered, and this research advocates an open planning process because it can offer a good possibility for further exploration into the participation problem.

The second assumption is that *designing systems would be able to function on a large scale only if they are supported by Information Communication Technology integrated in an overall Decision Support System.*

At this moment more than half the Dutch population has access to the Internet and the number grows daily. This means that technically, about 7 million citizens have the opportunity to participate in democratic communication with each other. Compared with traditionally used methods for citizen participation in spatial decision making, such as presentations, 'inspraak', discussions, meetings, workshops, design charettes and the like, the advantage of the Internet is obvious. The Internet is not merely a technical infrastructure, it is a way of life which can combine perfectly with the human network. Both the conceptual model and the prototype Delta•M offer an opportunity in that the human network will have an easier means of communication if a user-friendly and attractive Internet-based tool supports it.

Here we come to the field of the third assumption, which is:
The Delta•M DSS will provide an instrument for the operational realization of designing systems, by providing decision-making information, advice on choices on an individual level, and by improving the contact and interaction of the members of a designing system on the collective level.

The testing of the prototype and the evaluation of the conceptual model of the Delta•M DSS has shown that by using the Delta•M DSS, citizens, actors in decision making and their democratic representatives can interact better. The following issues of spatial decision making can be helped:

- Competent citizens will have dynamically updated and permanently available information about spatial plans, the status of legal procedures, and the profile and opinion of other participants in the decision-making process.
- Delta•M will provide personal advice on an individual level. The process of decision making would improve as a competent and informed individual opinion is a precondition for the success of collective negotiation.
- Advice will be obtained very quickly and easily, which will save time and increase the quality of discussions.
- The contact between citizens and their representatives will improve because they will have the opportunity to directly interact and discuss much more often than usual and citizens could be involved in the planning process from the very beginning. Therefore they will be able to influence the development of the plan and not merely comment on an already developed one. It is to be expected that in this situation, when the plan is completed, it will be a common product and there will not be any opposition to it. This will certainly improve the speed of decision making.
- As all disagreements in the plan development can be negotiated on time, rejection of the plan at a late stage by citizens will be less probable.

8.3 Results and contributions of the research

Here we will present the results and contributions of each of the chapters of this research.

In Chapter 1 we have defined the general goal of this research which is development of a tool for designing systems. We gave a definitions of designing systems and explained key terms of this research. The context and the main research problems were explained in relation to the spatial planning in the Netherlands. Possibilities of employment of decision support system for the improvement of spatial decision making were discussed and in that context the research assumptions defined. The framework and the method of the research were explained, generic tool requirements defined and constraints of the research put forward.

In Chapter 2 we investigated theoretical knowledge related to the democratization of decision-making processes and the improvement of the position of citizens in policy forming and decision making. Three theories were considered: Teisman's theory of pluricentric decision making, van Gunsteren's theory of citizenship, and the theory of electronic democracy, which is based on Habermas' ideas of the public sphere.

Pluricentric theory promotes changes in decision making so that the monolithic structure of government would be replaced by a network of interwoven organizations and individuals, where money, knowledge and legitimacy are divided in a non-hierarchical way. Teisman looks at pluricentric decision making from the point of view of investments in policy realization. This process already occurs spontaneously at some levels of decision making, in places where strong interaction between the public and private sector is needed for the implementation of policy.

In his theory of citizenship, van Gunsteren sees citizens as competent members of a community, where they execute their office in common with the government of this community. Van Gunsteren is aware of problems that might arise from this approach, such as 'who is in and who is out'. Yet he states that it would be more effective to acknowledge the differences among citizens and focus on the organization of these differences through plurality, the public realm and action, than to impose unity through uniformity.

We brought the pluricentric theory and the theory of citizenship into focus because, in our opinion, there cannot be any pluricentric decision making if there are no competent citizens who want to participate in the governing of a community. And they can participate only if they take a direct part in the policy-forming and decision-making processes.

We looked at the theories of electronic democracy and related them to the current situation in the distribution of the Internet and the availability of data and information on the Internet. We discovered that data that we needed for this research was not available on the Internet for free. This raised the issue of 'haves and have-nots', and the substantial question of how realistic electronic democracy is at this moment. And we were to discover that it is still at the very beginning of its development and, compared to regular democratic processes, marginally represented.

This would not however mean that the value of this research is diminished; on the contrary, we can say that we have come with these progressive ideas too early, and that the time of the full realization of electronic democracy, and thereby the implementation of the ideas of van Gunsteren and Teisman and ultimately of the Delta•M DSS in spatial planning practice, is yet to come. It is not easy to change established procedures even when they are 'fresh' and recently approved, and one can imagine how much time is needed to change the democratic procedures that have been established for centuries and which are imbedded in the culture of western citizens. Therefore this research proposes modification rather than complete change, and reinforcement rather than replacement.

We have taken the theories described above as a starting point for the definition of the first set of specific system requirements for the Delta•M DSS.

In Chapter 3 we reviewed the theoretical background and applications of decision support systems. We also looked at the implementation of DSSs in urban design and spatial planning.

The main theory behind the development of decision support systems is decision theory, which is based on rationality. The review of the literature on DSSs showed us that that there are many critics of rationality in decision theory, as human decision making is very much influenced by different cognitive styles, individual and situational circumstances, and the personal values of decision makers.

Looking at the implementation of DSSs in spatial planning we could see that there are many problems, mostly related to the complexity of spatial planning itself. It is relatively easy to make a specific DSS for a structured problem, but as spatial planning falls into the group of 'wicked' problems that have an unstructured nature and dynamic character, DSS technology has difficulties in getting to grips with this complexity.

There are certain steps which all scholars employ in the development of decision support systems, and which we also followed in this research. These relate to the following (they do not have to be executed in this order, but must be considered): modeling of a spatial problem or process; definition of system requirements; design and development of the DSS. We have also learned from the literature overview that in most cases, DSSs are not evaluated after they are implemented in the decision-making process. The reasons in most cases are that testing, evaluation and redevelopment cost too much time and money and most organizations take the risk of having an unsuccessful DSS or developing a new one, rather than improving the existing one. Looking at the advantages and disadvantages of several systems that were built for spatial planning purposes we have defined the second set of specific requirements for the Delta•M DSS.

The important result of this chapter was that the review of the literature and some non-commercially developed 'research applications' of spatial DSSs showed us that there are no computer applications available, either on the 'market' or in the 'laboratory' which we can use directly for integral support of the complete spatial planning process, from the first sketch development to the final decision about the plan. Our wide literature investigation showed that the main topic of this research is in many respects new in its approach.
Chapter 4 deals with four examples from Dutch spatial planning practice which we called case studies. We have followed four examples, each of them covering specific aspects of spatial decision making. The examples were: the Metropolitan Debate (*Het Metropolitane Debat*, HMD), the Masterplan South Axis (*Zuidas*) Amsterdam, the Deltametropolis project of the 'Architectural intervention' and the project entitled 'Open Place' (*Open Plek*).

The example of HMD was the most important as it has many common points with this research. The HMD method is itself an implementation of the theories of citizenship of van Gunsteren and pluricentrism of Teisman. It promotes the democratization of decision-making processes, and it also used a decision support system as part of the method. The analysis of the example provided us with knowledge about the reaction of citizens to the new decision-making methods, the relationship between the content and form of a method, where content is expressed through the relationship between projects and perspectives, and the method incorporates role-play simulation and a DSS. We learned a lot about problems in the practical development of the DSS and the implementation of the DSS in the decision-making process. This offered us a framework for the definition of the third set of specific system requirements for the Delta•M DSS.

In the example of the Masterplan South Axis we obtained knowledge on how citizens of a plan area can react to the plan, which aspects of the plan they find important and how they experience their surroundings. Here we also learned that the proportion of citizens in the Zuidas area that participated in the decision-making process about the Masterplan was low. In this example we were prompted to think about the means of information presentation and visualization of plans in order to make it more attractive to the citizens and thus improve participation. This experience was used in the design of the user interfaces of the prototype of the Delta•M DSS.

The example of the Deltametropolis website offered us a possibility to practically implement the knowledge gained from the other two examples. By developing the structure, database and the visualization approach for this website we could practice how to integrate creativity, knowledge and designing skills in order to communicate spatial plans better. Despite some difficulty in terms of the motivation and willingness of the students to deliver material for the website, it still managed to become a good example not only for the other ateliers of the Faculty of Architecture, but also worldwide. Presenting it at several international conferences we got much more positive reaction than criticism.

The example of "Open Place – No man's land?" can be seen as a technical failure but it also provided us with new knowledge. People often tend to blame the technology if it fails. But we have to remember the saying that 'guns do not kill, people do'. The example of "Niemands land?" showed us once again that the successful use of technology is in the hands of people. In addition, through personal involvement in this example we were able to experience in practical terms how important the human network is in stimulating participation, and how important the influence of the media is.

In Chapter 5 we implemented all the knowledge gained in the theoretical and empirical research into the design of the conceptual model of the Delta•M DSS. To be able to develop the conceptual model of the Delta•M DSS we had to translate the theories into some kind of operational framework. This operational framework is defined by the tool requirements presented in the conclusions of Chapters 2, 3 and 4. The value of the process of translation of ideal-utopist theories into a practical application is that it raises the implementation value of the theories and provides the possibility for their testing in real life.

After the requirements were set up, we developed different parts of the Delta•M DSS in order to fulfil these requirements, and the Delta•M DSS as a whole in order to fulfil the generic requirements. We described the data model and gave a reference example of the kinds of data that will be used as the system's input. We developed the knowledge base and the matching system of Delta•M and provided the specification of the technologies that can be used to develop the tool in practical terms. We also presented examples of existing technologies that can be used in the development of the Delta•M DSS.

The main achievement of this part of the research is that it created the conceptual models of the Delta•M DSS as an integrated tool that covers the parts of the planning process which concerns individual decision and the collective interaction of the designing system.

Chapter 6 presents the prototype of the Delta•M DSS. The most innovative part of the conceptual model, the matching system, is developed as a very simple prototype. The prototyping method gave us an opportunity to once again check the practical value of the conceptual model. The prototype gives additional value to this research because the realization of an operational prototype requires not only theoretical, but also practical knowledge and skills.

The prototype was tested and evaluated and conclusions about positive sides, weak points and future improvements were made. In this way the prototype development also enhanced the knowledge obtained through the theoretical and empirical research because, according to Schön (1983), "the development of the tool can be seen as a generation of new knowledge".

In Chapter 7 we evaluated the Delta•M DSS in relation to the system requirements. We also looked at the applicability of both the prototype and the complete Delta•M DSS.

The *prototype* of the Delta•M DSS is already in use by the Deltametropolis design studio. But we also looked at the possibilities for the direct practical implementation of the prototype in other planning situations. We suggested changes that should be made to the database content and visualization of information in the case of different implementation.

The applicability and utility of the *complete* Delta•M DSS was considered. The applicability of the system is given in relation to problems in spatial planning, and there we explained how the Delta•M DSS could help solve these specific problems or situations.

8.4 The novelty of the research

This research devises the designing system as most convenient for the improvement of the quality and speed of decision making in spatial planning.

The translation of the ideal-utopist theories of van Gunsteren and Teisman into a practical application raises the implementation potential of the theories and provides the possibility for their testing in real life.

This research develops an integrated DSS that can support citizens' participation in the complete process of plan development, from the sketchpad to the final decision.

This research results in an operational prototype for a small but essential component of the DSS, which is an unusual practice in the world of Ph.D. research.

8.5 Achievements of the research

The achievements of this research can be divided in two groups, whereby one represents achievement of a *theoretical* kind, and the other concerns achievements in the *application* side of the research.
We consider the *theoretical* achievements to be the following:

1. This research provides a theoretical model for the development of a decision support system for spatial planners.
2. This research integrates different scientific theories in an Internet-based tool.
3. The Delta•M tool provides an infrastructure for the realization of the theories of citizenship, pluricentricism and electronic democracy in the domain of spatial planning. Figure 8.1 shows the

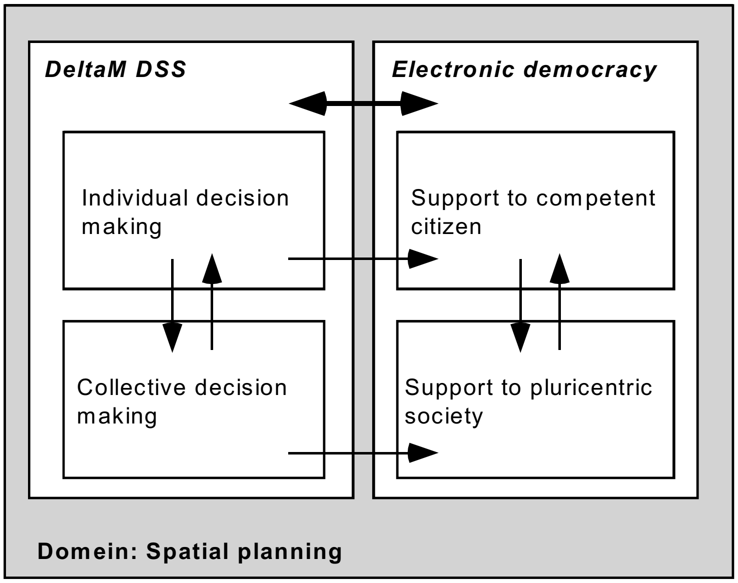


Figure 8.1 Achievements of the Delta•M DSS concerning the theories of citizenship, pluricentricism and electronic democracy

contribution of the Delta•M DSS in the realization of these theories. The part of the Delta•M DSS aimed at individual opinion forming enlarges and supports the competence of citizens. The tools for collective interaction of the Delta•M DSS provide a platform for pluricentric decision making. The Delta•M DSS as a whole is an application of electronic democracy in the domain of spatial planning.

4. The Delta•M DSS provides an opportunity for the further exploration of citizens' participation in processes of democratization.
5. This research provides an analytical systematization of problems related to the implementation of decision support systems in spatial planning.
6. The research introduces a matching system that provides an integration of generic and applied knowledge of spatial planning with users' preferences.
7. The research results in the development of the first prototype of the Delta•M DSS which is available at www.bk.tudelft.nl/ai/deltametropool/deltam.html
8. This research developed a testing methodology for Internet-based decision support systems.

The *application* achievements of the research can be seen in relation to the generic system requirements presented in section 1.9:

1. All information about plans under consideration is stored in one place (shortening the time).
2. The place is open for everyone and permanently available (shortens time/supports open planning).
3. There is an agent to help with understanding the spatial problem and choosing an alternative solution (shortens time/improves quality).
4. Information is well-structured and presented in a visually attractive way (improves quality/shortens time).
5. The tools for collective interaction provide contact, communication, and negotiation between participants (improved communication/providing satisfactory decisions).

8.6 Limitations of the research

The biggest disadvantage of this research is that there was no time to develop the complete Delta•M DSS. Therefore the evaluation of the complete system is based on theoretical suppositions and estimation.

The prototype of the Delta•M DSS is just the first prototype, and there was no time to improve it using knowledge obtained in testing and evaluation.
Because of the low number of participants in the case studies research, we cannot say whether the theory of citizenship is realistic. Additional deeper research has to be done in the field of citizen participation so as to be able to confirm or refute the theory.

The applicability of the Delta•M DSS in the democratization of spatial decision making can be confirmed with certainty only if it is applied to a statistically representative number of citizens. However, this is expensive and time-consuming and requires further research.

8.7 Further research

Further research in the theoretical field which might contribute to the development of the Delta•M DSS concerns the findings of cognitive science about human inference and decision making. These can be used for the improvement of the matching system.

Findings about citizens' spatial preferences, originating from the practice of spatial planning, can be used for the improvement of the knowledge base and the system's easier recognition of a user profile.

The research and implementation of the Semantic Web is also very important for the successful implementation of the Delta•M DSS.

Developments in visualization techniques of urban and rural environments, especially those that are applicable via the Internet, can contribute to the improvement of techniques currently used for the presentation of spatial data.

The research presented here was restricted to the development of the first prototype of the Delta•M DSS. The next steps in the research would be the improvement of the prototype and the development of the complete Delta•M DSS. To this end, deeper investigation of citizens' opinions about spatial planning and decision making would be needed. The constant production of spatial plans in the Netherlands on all management levels and for all parts of spatial systems offer almost daily opportunities to experiment with new methods of decision making. And this happens continuously. Hence we argue that every opportunity to apply the Delta•M DSS in planning practice, even the most modest one, can contribute to the improvement of the knowledge about the applicability and value of decision support systems for spatial planning and therefore to the enhancement of the quality and speed of spatial decision making.

List of terms

List of terms

A

Actors - see Stakeholders

Agents - Self contained processes that run in the background on a client or server and that perform useful functions for a specific user/owner. Agents may monitor exceptions based on criteria or execute automated tasks. Agents thus represent the ability of the computer to accomplish something on behalf of the user (Minsky & Riecken 1994). To do this they posses high-level knowledge about a particular task domain or domains.

Algorithm – A step-by-step approach for computing a solution to a mathematical problem.

Aqua Browser - Aqua Browser is a fuzzy visualization tool which shows the high level description of a concept space hiding irrelevant information and visualizing information elements in context

B

Behavioral decision theory - Aspires to give an account and explanation of human behavior - in particular human decisions. Generally speaking behavioral decision theory concerns the use of decision theory in conceptualizing and understanding human behavior.

C

Cognitive Overload - A psychological phenomenon characterized by an overload of information for a decision-maker. The amount of information exceeds the person's cognitive capacity. DSS can reduce or increase cognitive overload.

Complex - Composed of interconnected or interwoven parts (Webster, 1984).

D

Data - Binary (digital) representations of atomic facts, text, graphics, bit-mapped images, sound, analog or digital live-video segments. Data is the raw material of a system supplied by data producers and is used by information consumers to create information. Data are facts which can be used as a basis for reasoning (Johnson et al., 1967).

Database - A database is a collection of related data. By data, we mean known facts that can be recorded and that have implicit meaning (Elmasri & Navathe, 2000 p. 4). A database represents certain aspects of the real world (*miniworld*), sometimes called the *Universe of Discourse* (UoD). Changes to the UoD are always reflected in the database. A database is designed, built and populated with data for a specific task and intended group of users.

Database management system [DBMS] - A database management system is a collection of programs that enables users to create and maintain databases. The DBMS is hence a general-task software system that facilitates the process of defining, constructing and manipulating databases for various applications. One DBMS creates possibilities for more users to simultaneously use different operations of the same data from the database (data concurrency).

Data Quality - High quality data is accurate, timely, meaningful, and complete. DSS must have high quality data; low quality data can result in bad decisions.

Data Visualization - Presenting data and summary information using graphics, animation, 3-D displays, and other multimedia DSS tools.

Designing System – A coalition of designers, actors and citizens.

Decision - The choice of one from among a number of alternatives; a statement indicating a commitment to a specific course of action.

Decision Frame - Decision frame refers to the decision-maker's conception of the acts, outcomes, and contingencies associated with a particular choice. The frame that a decision-maker adopts is controlled partly by the formulation of the problem and partly by the norms, habits, and personal characteristics of the decision-maker.

Decision Theory – Decision theory concerns the hypothesis that human behavior is, as a rule, rational. In decision theory, a rational man is one who, when confronted with a decision situation, makes the choice (decision) that is best for him. This best decision is called a rational or optimal decision.

Decision Analysis tools - DA tools help decision makers decompose and structure problems. The aim of these tools is to help a user apply models like decision trees, multi-attribute utility models, bayesian models, Analytical Hierarchy Process (AHP), etc. Examples of DA software packages include AliahThink, BestChoice3, Criterium Decision Plus, DecideRight, DecisionMaker, Demos, DPL, Expert Choice, Strad, Supertree, and Which and Why.

Decision Support Systems [DSS] - are interactive computer-based systems intended to help decision makers utilize data and models to identify and solve problems and make decisions. The "system must aid a decision maker in solving unprogrammed, unstructured (or "semistructured") problems...the system must possess an interactive query facility, with a query language that ...is ...easy to learn and use (Bonczek, Holsapple & Whinston, 1981; p. 19)". DSS help managers/decision makers use and manipulate data; apply checklists and heuristics; and build and use mathematical models. According to Turban (1990), a DSS has four major characteristics: DSS incorporate both data and models; they are designed to assist managers in their decision processes in semistructured (or unstructured) tasks; they support, rather than replace, managerial judgment; and their objective is to improve the effectiveness of the decisions, not the efficiency with which decisions are being made.

Deltametropolis - Urbanised area in the Rhine delta (EU) in between North sea, North Sea Canal, New Water Defence Line and Merwede / Oude Maas / New Waterway, an area of some 5000 sqkm, 5 mln inhabitants and 2.2 mln jobs.

Design – To project, to form an idea, as a scheme. To purpose or intend. To plan, to form an outline or representation of any thing (Webster).

Domain Expert - A person who has expertise in the domain in which a specific expert system is being developed. A domain expert works closely with a developer (known as a knowledge engineer) to capture the expert's knowledge (especially rule and relationship information) in a computer readable representation often called a knowledge base.

DSS Generator - Computer software package that provides tools and capabilities that help a developer quickly and easily build a specific Decision Support System.

E

Empirical – To rely or base something on observation (data). An empirical approach uses existing observation/data to develop relationships to solve a problem (i.e., there is no hard science involved).

Entity-Relationship [ER] Model – is a popular high-level conceptual data model. This model and its variations are frequently used for the conceptual design of database applications.

Evaluation - the systematic assessment of the worth or merit of some object. It implies that someone is examining and weighing a phenomenon against some explicit or implicit yardstick (Weiss, 1972).

Executive Information Systems [EIS] - A computerized system intended to provide current and appropriate information to support executive decision making for managers using a networked workstation. The emphasis is on graphical displays and an easy to use interface that present information from the corporate database. They are tools to provide canned reports or briefing books to top-level executives. They offer strong reporting and drill-down capabilities.

Expert Systems - are man-machine systems with specialized problem-solving expertise. It is a modeling approach that incorporates human judgment and expertise, both quantitative and qualitative, in a decision-making framework.

G

Geographic Information System [GIS] - An information system that represents data using maps. It helps people access, display and analyze data that have geographic content and meaning.

Group Decision Support System [GDSS] - An interactive, computer-based system that facilitates solution of unstructured problems by a set of decision-makers working together as a group.

Groupware - Is software designed to support more than one person working on a shared task. Groupware is an evolving concept that is more than multiuser software which allows access to the same data. Groupware provides a mechanism that helps users coordinate and keep track of on-going projects. It allows people to work together through computer-supported communication, collaboration, and coordination.

I

Information - Data that has been processed to add or create meaning and hopefully knowledge for the person who receives it.

Information system - An information system is a collection of activities that regulate the sharing and distribution of information and the storage of data.

Internet - The Internet (capitalized) refers specifically to the DARPA Internet and the TCP/IP protocols it uses. The Internet is a collection of packet-switching networks and routers that uses the TCP/IP protocol suit and functions as a single, cooperative virtual network. A global web connecting more than one million computers.

Interaction – mutual and simultaneous activity on the part of both participants, usually working toward some goal. One of the core concepts of interactivity is giving control to the user: user, not the designer of the system controls the sequence, the place, and what to look at and what to ignore.

Interactivity – is a process involving movement, change, feedback and action. It is aimed at communication, learning, developing new skills and creativity.

K

Knowledge Base - A collection of facts, rules, and procedures. The assembly of all the information and knowledge (theoretical and empirical) of a specific field of interest.

L

Liquid Solutions technology - uses semantic networks to process information according to users' preferences and then visualizes it in a dynamic way.

M

Model – A model is an object or a concept that is used to represent the real situation, an abstract framework that is well understood. A model is a plan for information processing that involves some transformation of information. Models are tools for extending a decision maker's capacity for coping with complex large scale problems. (Bonaczek et al. 1981).

Model Base - A collection of preprogrammed quantitative models (e.g.,statistical, financial, optimization) organized as a single unit.

Modeling Tools - Software programs that help developers/users build models quickly.

N

Neural networks - are computing systems made up of a number of simple, highly interconnected processing elements which process information by their dynamic state response to external inputs (Hetch-Nielsen, 1988, p.32). A neural network is a computational device which, in certain ways, functions similarly to the human brain.

O

Object - A person, place, thing, or concept that has characteristics of interest to an environment. In terms of an object-oriented system, an object is an entity that combines descriptions of data and behavior.

Object Orientation - is a recent "strategy for organizing systems as collections of interacting objects that combine data and behavior." (Blaha & Premerlani, 1998 p. 1). The object-oriented strategy creates a powerful synergy throughout the development life cycle by combining: *abstraction*: allows a focus on essential aspects of an application while ignoring details, preserves design freedom until the later stages of development and this is probably the most important skill required from object-oriented development; *encapsulation*: separates external specification from internal implementation; and *modularity/inheritance*: promotes coherence, understandability and symmetry by organizing a system into groups of closely related objects.

Object-oriented database - can be regarded as a persistent store of objects created by an object-oriented programming language. The concept of *objects, class, abstract data type* and *encapsulation* was proposed. Object-oriented databases have adopted many of the concepts that were developed originally from object-oriented programming languages. One goal of object-oriented databases is to maintain a direct correspondence between the Universe of Discourse and database objects, so that objects do not lose their identity and can easily be identified and operated upon.

P

Perspective - is a program for a desirable socio-economic development for areas of considerable size and periods of considerable time that are beyond human regulation, specified in a map and /or other types of visual presentation of the environmental quality that is desired.

Plan – a scheme or program for making, doing, or arranging something; project, design, schedule, etc.
Plan refers to any detailed method, formulated beforehand, for doing or making something; *design* stresses the final outcome of a plan and implies the use of skill or craft, in executing or arranging this (Webster New World Dictionary).

Planning – To make plans. A managerial function concerned with making forecasts, formulating outlines of things to do, and identifying methods to accomplish them.

Planning Support Systems [PSS] - integrated systems of information and software which bring the three components of traditional DSSs - information, models and visualization - into the public realm.

Projects - are concrete spatial interventions that are defined in extent and time so that they can be executed by a principal.

Project portfolio - combination of projects, aimed at realising a certain perspective.

Prototyping - A strategy in system development in which a scaled down system or portion of a system is constructed in a short time, tested, and improved in several iterations. A prototype is an initial version of a system that is quickly developed to test the effectiveness of the overall design being used to solve a particular problem.

Q

Query - Generically query means question. Usually it refers to a complex SQL SELECT statement for decision support.

R

Rational Decision Behavior - Behavior that is goal-oriented in reaching a decision. Behavior is guided by the consequences likely to result from the selection of a given alternative. A decision-maker believes based upon analysis that a chosen alternative will result in achieving one or more desired objectives. Rational decision behavior should be supported by DSS.

Representation - The formulation or view of a problem. Developed so the problem will be easier to solve.

Rule - A formal way of specifying a recommendation, directive, or strategy, expressed as IF premise THEN conclusion.

S

Semantic Web - The technology that provides retrieval based on the meaning of the content of the Web pages.

Semistructured Decisions - Decisions in which some aspect of the problem are structured and others are unstructured.

Simulation - A technique for conducting one or more experiments that test various outcomes resulting from a quantitative model of a system.

Spatial Decision Support Systems [SDSS] - specific applications of DSSs used in physical planning. These are developed for use with a domain database that has a spatial dimension or for situations where the solution space of a problem has a spatial dimension (Wright and Buehler, 1993). SDSSs are thus a subset of the wider family of DSSs that focus on spatial (geographical) processes relevant to a particular decision problem (Carver, 1996). The essential characteristics of an SDSS is that it integrates a geographical information system (GIS) with a computer-based spatial analysis module, map analyses and display modules. In that sense an SDSS operates with maps and images more than other DSSs.

Spatial Planning – a process that uses a variety of tools (zoning, land use planning, transportation planning, environmental policy, housing programs, etc.) to achieve envisioned and desired goals within the natural and built environments.

Stakeholder - a person or group of people who have a share or a personal or financial involvement in a business (Cambridge International Dictionary of English).

Structured Decisions - Standard or repetitive decisions situations for which solution techniques are already available (also sometimes called routine or programmed decisions). The structural elements in the situation, e.g. alternatives, criteria, environmental conditions, are known, defined and understood.

T

Testing - is the measurement process of assessing the status of the system against certain criteria such as validity, effectiveness, efficiency, reliability, robustness, etc.

U

Unstructured Decisions - This type of decision situation is complex and no standard solutions exist for resolving the situation. Some or all of the structural elements of the decision situation are undefined, ill-defined or unknown. For example, goals may be poorly defined, alternatives may be incomplete or non-comparable, choice criteria may be hard to measure or difficult to link to goals.

Urban Design – the arrangement of the various parts – the houses, roads, paths, and so on – is such a way that they function properly, can be built economically, and give pleasure to look at (Gibberd, 1953, p. 20). Urban design includes technical questions of urban functioning, economic issues of cost and benefit, aesthetic issues of appearance, as well as social issues involving allocation and provision (Batty et al., 1998, p.1).

User-Friendly - An evaluative term for a Decision Support System's user interface. The phrase indicates that users judge the user interface as to easy to learn, understand, and use.

*User Interface [*or *"Human-Computer Interface"]* - The component of a computerized support system that allows bi-directional communication between the system and its user. This is also called the dialogue component of a DSS. An interface is a set of commands or menus through which a user communicates with a program.

W

"What If" Analysis - The capability of "asking" the software package what the effect will be of changing some of the input data or independent variables.

Summary

Summary

This research deals with the development of a tool to enable designers, decision-makers and citizens to jointly shape the physical environments they inhabit, through interaction and communication via electronic networks. The designing of physical environment becomes the collective responsibility of all interested societal actors, who together form a 'designing system'. This research defines a 'designing system' as a temporary alliance of people responsible for decisions about the spatial development of an area, consisting of public and private investors, and citizens.

This research involved the integration of theoretical knowledge, empirical knowledge and information communication technologies (ICT) in order to develop a tool, the decision support system called Delta•M.

The theoretical background of the research originates from the theories of citizenship (Van Gunsteren), pluricentric decision making (Teisman) and electronic democracy (which is very much based on the theory of Habermas). Empirical knowledge is gained through four case studies. The possibilities of ICT were used to accommodate the theoretical background. This resulted in the proposition for the development of the *Delta•M Decision Support System* as a tool that should help 'designing systems' to jointly shape their metropolitan environments. The purpose of the tool is to improve the quality and speed of spatial decision making.

The research resulted in the design of the *conceptual model* of the Delta•M DSS and the *prototype* application of a part of the conceptual model.

The *conceptual model* provides a complete description of the Delta•M DSS so that thereafter it can be easily constructed and implemented in spatial planning practice. The computational aspect of the conceptual model is provided by the combination of Object-Oriented Database System, Semantic Web and Liquid Technologies for data visualization. The Delta•M DSS is developed for an open planning process and will be implemented via the Internet.

In the prototype of the Delta•M DSS, part of the conceptual model, the matching system, is developed and tested. It is available at www.bk.tudelft.nl/deltametropool/deltam.html

The aim of the prototype is to help individual citizens to orient themselves and choose from among many different spatial plans that are available for a certain territory. The testing of the prototype has shown that it is already sufficiently mature to be implemented in spatial planning practice.

The novelties of this research are that it conceives of the designing system as most convenient for the improvement of the quality and speed of decision making in spatial planning, and it translates the ideal-utopist theories of van Gunsteren and Teisman into a practical application, which raises the implementation potential of the theories and provides the possibility for their testing in real life. This research also results in an integrated DSS that can support the complete process of plan development, from the sketchpad to the final decision and, finally, this research results in an operational prototype, which can be implemented in spatial planning practice.

Samenvatting

Samenvatting

De onderhavige studie betreft de ontwikkeling van een instrument waarmee het ontwerpers, beleidsvormers en burgers mogelijk wordt gemaakt om via interactie en communicatie langs electronische netwerken gemeenschapelijk vorm te geven aan de fysieke omgeving die zij bewonen. Het ontwerpen van de fysieke omgeving wordt een gezamenlijke verantwoordelijkheid van alle belanghebbende maatschappelijke acteurs die met elkaar een „ontwerpend systeem" vormen. In het kader van deze studie wordt het „ontwerpend systeem" gedefinieerd als een tijdelijk verbond van personen die verantwoordelijk zijn voor beslissingen betreffende de ruimtelijke ontwikkeling van een gebied, namelijk publieke en particuliere investeerders en burgers.

De studie impliceerde de integratie van theoretische kennis, empirische kennis en informatie en communicatietechnologie (ICT) waarmee een instrument ontwikkeld werd, te weten het beslissingsondersteunende systeem Delta•M.

De theoretische achtergrond van de studie is gebaseerd op de theorieën over burgerschap (Van Gunsteren), pluricentrische besluitvorming (Teisman) en electronische democratie (zeer sterk leunend op Habermas). De empirische kennis werd vergaard door vier case studies uit de praktijk van de ruimtelijke ordening. De mogelijkheden die ICT biedt werden gebruikt om de theoretische achtergrond te plaatsen. Dit resulteerde in het voorstel voor de ontwikkeling van het *Delta•M Decision Support System* als instrument dat de „ontwerpende systemen" helpt om gezamenlijk stedelijke omgevingen te scheppen. Doel van het instrument is de verbetering van de kwaliteit en van de snelheid van de ruimtelijke besluitvorming.

De studie leidde tot het ontwerp van het *conceptuele model* Delta•M DSS en het *prototype* van een deel van het conceptuele model.

Het *conceptuele model* biedt een volledige beschrijving van het Delta•M DSS zodat het voortaan makkelijk construeerbaar is. In de computationele aspecten van het conceptuele model is voorzien door de combinatie van Object-Oriented Database System, Semantic Web en Liquid Technologies voor data visualisering. Delta•M DSS werd voor een open planning proces ontwikkeld en zal via internet worden geïmplementeerd.

In het prototype van Delta•M DSS wordt een deel van het conceptuele model, namelijk het aanpassingssysteem (matching system) ontwikkeld en getoetst. Het is beschikbaar op www.bk.tudelft.nl/deltametropool/ deltam.html. Doel van het prototype is het helpen van de individuele burger bij het zich oriënteren en bij het kiezen uit de vele verschillende plannen voor ruimtelijke ontwikkeling die voor een bepaald gebied ter beschikking staan. Tijdens het testen van het prototype bleek dat het al rijp is om in de praktijk van de ruimtelijke ordening te worden toegepast.

De noviteit van deze studie bestaat in de conceptie van het ontwerpend systeem als het meest geschikte systeem voor de verbetering van de kwaliteit en van de snelheid van de besluitvorming in de ruimtelijke ordening, en de vertaling van de ideaal-utopistische ideeën van Van Gunsteren en Teisman in een praktische toepassing. Daardoor wordt het implementatiepotentieel van de theorieën verhoogd en wordt de mogelijkheid geschapen om hen in een ‚real life'-situatie te testen. De onderhavige studie leidt ook tot een geintegreerd DSS dat het gehele proces van planontwikkeling, van het schetsblok tot de uiteindelijke beslissing, ondersteunt. Tenslotte resulteert deze studie in een operationeel prototype dat in de praktijk van de ruimtelijke ordening kan worden toegepast.

Appendix

Table 1. Explanation of the calculation of matching

Urban voorbeeld, uitgewerkt voor Lage land en

Transrapid station

Class	Object		Userscore	Lage land		transrapid	
Activity			1	1		1	
	Care		100	50	50	50	50
	work		0	50	50	50	50
	learning		0	0	0	0	0
	sport		0	0	0	0	0
		stap 1:	100	**som objectfout:**	100	**som objectfout:**	100
		stap 2:	1	**stap 3:**	25	**stap 3:**	25
				stap 4:	25	**stap 4:**	25
Values			1	1		1	
	Economy		0	100	100	100	100
	ecology		0	0	0	0	0
	cultural div		0	0	0	0	0
	social eq		0	0	0	0	0
		stap 1:	0	**som objectfout:**	100	**som objectfout:**	100
		stap 2:	0	**stap 3:**	25	**stap 3:**	25
				stap 4:	200	**stap 4:**	200
land use system			1	1		1	
	water		0	0	0	0	0
	urban		75	80	5	0	75
	landscape		0	0	0	0	0
	connections		25	20	5	100	75
		stap 1:	100	**som objectfout:**	10	**som objectfout:**	150
		stap 2:	1	**stap 3:**	2,5	**stap 3:**	37,5
				stap 4:	2,5	**stap 4:**	37,5
location			1	1		1	
	big city		100	100	0	0	100
	town		0	0	0	0	0
	village		0	0	0	0	0
	rural area		0	0	0	100	100
		stap 1:	100	**som objectfout:**	0	**som objectfout:**	200
		stap 2:	1	**stap 3:**	0	**stap 3:**	50
				stap 4:	0	**stap 4:**	50
Greenery			1	1		1	
	100		0	0	0	0	0
	500		0	0	0	0	0
	1000		0	0	0	0	0
	not imp.		100	100	0	100	0

		stap 1:	100	som objectfout:		0	som objectfout:		0
		stap 2:	1	stap 3:		0	stap 3:		0
				stap 4:		0	stap 4:		0
Accessebility			1		1			1	
	car		100		50	50		50	50
	public trans		0		50	50		50	50
	not imp.		0		0	0		0	0
		stap 1:	100	som objectfout:		100	som objectfout:		100
		stap 2:	1	stap 3:		33,33	stap 3:		33,333
				stap 4:		33,33	stap 4:		33,333
water			1		1			1	
	100		0		0	0		0	0
	500		0		0	0		0	0
	1000		0		0	0		0	0
	not imp.		100		100	0		100	0
		stap 1:	100	som objectfout:		0	som objectfout:		0
		stap 2:	1	stap 3:		0	stap 3:		0
				stap 4:		0	stap 4:		0
				stap 5: som van stappen 4:		260,8			345,83

nieuw scoreprincipe:

stap 1: bereken voor elke klasse de classscore, dit wordt alleen gebruikt als weegfactordit is de score op de klasse, vermeningvuldigd met de som van score op objecten
Voorbeeld:
Voor de klasse activity is dit: 1 * (100 + 0 + 0 + 0) = 100
dit zijn de groene getallen

stap 2: Bereken hieruit per klasse de weegfactor
dit is de klassescore van de klasse, gedeeld door de hoogste classscore
voorbeeld voor water: 100 / 100 = 1
dit zijn de rode getallen

stap3: bereken de objectfout, deze bestaat uit de som van verschillen op objecten, gedeeld door het aantal objectendit zijn de blauwe getallen

stap4: deel de objecten door de weegfactor uit stap 2.
dit zijn de getallen met de paarse achtergrond.
Als de weegfactor gelijk is aan 0, dan worden de getallen op de maximale fout gezet, dat is hier 200.

stap5: Deze getallen worden per project bij elkaar opgeteld.
Dit zijn de getallen met de blauwe achtergrond.
Het project dat hier de laagste score heeft, is het beste project.

stap 6: **vervolgens wordt dit getal voor het leuke uiterlijk gedeeld door de maximaal haalbare fout en in een positief percentage omgezet, dit is het getal dat je ziet bij de resultaten in de browser.**

Table 2. Questionnaire for the avaluation of the DeltaM prototype

Please evaluate the DeltaM system by choosing one of the options of the questions and/or writing your comments in the row under the question.

You will be asked 46 questions.
The values of possible answers range from 1 to 5:
1 completely disagree
3 neither agree nor disagree
5 completely agree.

C is for your comments

A Usability

		1	2	3	4	5
	General ease of use					
1	The system DeltaM is easy to use.					
C						
2	The DeltaM's input screens are easy to use.					
C						
3	The displays are easy to read.					
C						
4	The displays are easy to understand.					
C						
	Consistency					
5	The system DeltaM uses the same layout for all the screens.					
C						
6	The system presents the similar information at the same place of the screen.					
C						
7	The same commands produce the same actions throughout the system.					

C						
8	All the parts of this web site are clearly labeled.	2	2	2	2	2
C						

Attractiveness

9	This web site is presented in an attractive way.	2	2	2	2	2
C						
10	I enjoy the experience of using this web site.	2	2	2	2	2
C						

Control

11	Going from one part to another is easy on this web site.	2	2	2	2	2
C						
12	I feel in control when I'm using this web site.	2	2	2	2	2
C						

Efficiency

13	Completing the task to choose the project using the DeltaM is faster than current procedures.	2	2	2	2	2
C						
14	It is easier to choose the project using the DeltaM then with current procedures.	2	2	2	2	2
C						
15	The suggested list of projects meets my needs.	2	2	2	2	2

C

16	I would feel comfortable using DeltaM under time pressure.					

C

17	The response time is fast enough to keep me interested.					

C

Learnability

18	The system DeltaM requires no training for infrequent users.					

C

19	All the material is presented in a way that is easy to understand.					

C

20	The system has enough help features.					

C

B System Content Evaluation

Process quality

21	I agree with the list of questions that were put to me.					

C

22	I agree with the scoring system applied for the classification of projects					

C

23	I have enough data to decide whether I like some project or not..					

C

24	The system DeltaM is using right data to inform user about projects.					
C						
25	The visual presentation of data is good.					
C						
26	I agree with the matrix that DeltaM uses to present the projects.					
C						
27	The system DeltaM uses a logically sound approach to support user in selecting preferable projects among many.					
C						
28	The system DeltaM contains an adequate level of expertise to support users performing selection of projects.					
C						
29	The system allows users examine expertise on which system's recommendation is based.					
C						
30	The system contains familiar terms.					
C						

Product quality

31	Overall, the system DeltaM provided me with useful results.					
C						
32	Overall, the reasoning underlying the results is acceptable.					
C						
33	It is easy to interpret the results of the DeltaM.					

C						
34	It was easy to form a mental picture of how the system DeltaM works.	?	?	?	?	?
C						
35	It was easy to understand why the results came out the way they did.	?	?	?	?	?
C						

Overall confidence

36	I have a lot of confidence in the results obtained working with DeltaM	?	?	?	?	?
C						
37	I am confident that DeltaM is well built technically.	?	?	?	?	?
C						
38	I have a lot of confidence in the DeltaM's approach to quick selection among many projects is good.	?	?	?	?	?
C						
39	I was not influenced by the opinion of other participants shown in the statistics next to the answers on the questions.	?	?	?	?	?
C						

Please enter some data about you

Your name

40

Your e-mail address

41

Your age

42

43 Your sex is:

Female

Male

Your profession is:

44

45 Your role in physical planning is (you can chose more than one role):

inhabitant of a country (consumer of the space)

citizen (a part of a community; a chooser of a future spatial development)

land owner

investor in spatial projects

a member of a social group that has interest in spatial policy (nature protection, monuments protection, etc)

public authority (building permission issuing organization)

other

46 How experienced Internet user you are?

I use Internet a lot

- I use Internet sometimes
- I never use Internet myself, but I look sometimes when somebody else shows me something.

Submit Reset

Table 3. Results of the usability testing and empirical evaluation per person

	A	B	C	D
1		Table 3. Results of usability testing and empirical evaluation per person		
2				
3	Your+name	Your name	Andre+Dan	Donna Lucke
4	adres	e-mail address	andre%40k	donnal@uka
5	Profession	Your profession is:	Transportat	Associate+Pr
6	age			
7	A	**Usability**		
8		**General ease of use**		
9	A1	1. The system DeltaM is easy to use.	5	4
10	A2	2. The DeltaM's input screens are easy to use.	5	5
11	A3	3. The displays are easy to read.	5	2
12	A4	4. The displays are easy to understand.	1	5
13		**Consistency**		
14	A5	5. The system DeltaM uses the same layout for all the screens.	5	2
15	A6	6. The system presents the similar information at the same place of the screen.	5	5
16	A7	7. The same commands produce the same actions throughout the system.	1	5
17	A8	8. All the parts of this web site are clearly labeled	1	3
18	A9	9. This web site is presented in an attractive way	2	3
19	A10	10. I enjoy the experience of using this web site	2	3
20		**Control**		
21	A11	11. Going from one part to another is easy on this web site	3	5
22	A12	12. I feel in control when I'm using this web site	3	3
23		Efficiency		
24	A13	13. Completing task to choose a project using the DeltaM is faster then current procedures.	3	3
25	A14	14. It is easier to chose a project using the DEltaM that with current procedures.	3	3
26	A15	15. The suggested list of projects meets my needs	3	3
27	A16	16. I would feel comfortable using DeltaM under the time preasure	3	5
28	A17	17. The response time is fast genough to keep me interested	3	5
29		**Learnability**		
30	A18	18. The system DeltaM requires no training for infrequent users.	1	5
31	A19	19. All the material is presented in a way that is easy to understand.	1	4
32	A20	20. The system has enough help features.	1	4
33		**Sytem Content Evaluation**		
34		**Process quality**		
35	B21	21. I agree with the list of questions that are put to me	1	3
36	B22	22. I agree with the scoring system applied for the classification of projects	1	3
37	B23	23. I have enough data to decide whether I like some project or not.	1	3
38	B24	24. Tha system DeltaM is using right data to inform user about projects.	1	3
39	B25	25. The visual presentation of data is good.	1	3
40	B26	26. I agree with the matrix that DM uses to present the projects.	1	3
41	B27	27. The system DM uses logicaly sound approach to support user in selecting preferable proj	1	3
42	B28	28. The system DM contains an adequate level of expertise to support users performing sele	1	3
43	B29	29. The system allows users to examine expertise on which systems' recommendation is bas	1	1
44	B30	30. The system contains familiar terms.	3	3
45		**Product quality**		
46	B31	31. Overall, the system DM provided me with useful results.	2	3
47	B32	32. Overall, the reasoning underlaying the results is acceptable	2	3
48	B33	33. It is easy to interpret the results of the DM.	1	4
49	B34	34. It was easy to form a mental picture of how the system DM works.	1	3
50	B35	35. It was easy to understand why the results came out the way they did.	1	3
51		**Overall confidence**		
52	B36	36. I have a lot of confidence in the results obtained working with DM	1	2
53	B37	37. I am confident that DM is well built technically.	3	2
54	B38	38. I have a lot of confidence in the DM's approach in quich selection among many projects.	1	1
55	B39	39. I was not influenced by the opinion of other participants shown in the statistics next to the	4	1
56		**Data about participants**		
57	P43	43. Your sex	2	1
58		45. Your role in physiscl planning is		
59	P45_1	inhabitant of a country	No	Yes
60	P45_2	citizen	No	Yes
61	P45_3	land owner	No	Yes
62	P45_4	investor	No	No
63	P45_5	member of a social group	No	Yes
64	P45_6	public authority	No	No
65	P45_7	other	consultant	Professor+of
66	P46	46. How experienced internet user you are?	1	2

	D	E	F	G	H	I	J	K
3	Donna Lucke	Peter+de+Jor	teisman	K.+Moraes+Z	Perica Savanovic	A.M.+Feranandez	Latifa+Chouide	Alinta+Thornton
4	donnal@uka	p.dejong@bk.	teisman%	K.MoraesZarzar@bk.tudelft.nl		a.m.fernandez-m	chouider@colb	athornton%40wr
5	Associate+Pr	coordinator+c	scientist	Promovenda%	student	Urban+researche	Graphic+desing	user+interface+
6							37	+took+a+very+l
7								
8								
9	4	4	3	5	5	5	5	1
10	5	4	3	5	4	5	5	1
11	2	4	3	5	4	5	4	1
12	5	4	2	5	4	4	3	1
13								
14	2	4	2	5	5	5	1	x
15	5	5	3	5	5	5	5	x
16	5	5	2	5	4	5	3	x
17	3	2	2	3	3	5	3	1
18	3	4	3	3	2	5	4	2
19	3	3	4	4	2	4	5	1
20								
21	5	3	3	5	4	5	4	1
22	3	4	4	5	4	4	5	1
23								
24	3	5	3	3	4	4	x	1
25	3	3	3	3	5	3	x	x
26	3	3	2	3	3	3	1	x
27	5	x	3	3	3	4	5	1
28	5	4	4	2	5	4	3	1
29								
30	5	5	1	3	5	4	5	2
31	4	4	2	3	4	4	5	1
32	4	2	3	x	4	3	1	1
33								
34								
35	3	x	2	5	3	3	5	x
36	3	x	2	3	3	3	1	x
37	3	2	2	3	2	2	1	1
38	3	2	3	x	3	4	3	x
39	3	2	3	5	3	4	5	2
40	3	x	3	5	3	4	5	x
41	3	x	2	5	4	4	1	1
42	3	x	2	3	4	4	5	x
43	1	x	3	1	4	3	5	1
44	3	4	3	5	5	5	5	1
45								
46	3	x	3	4	4	3	3	1
47	3	x	2	x	4	4	3	x
48	4	4	2	4	4	5	3	x
49	3	4	2	5	3	5	4	1
50	3	4	2	5	3	3	3	1
51								
52	2	x	3	4	4	4	5	1
53	2	x	3	5	5	4	5	3
54	1	4	3	5	4	4	5	1
55	1	4	3	4	5	5	4	1
56								
57	1	2	2	1	2	1	1	1
58								
59	Yes	No	No	Yes	Yes	Yes	Yes	Yes
60	Yes	No	No	Yes	Yes	Yes	No	Yes
61	Yes	No	No	No	No	No	No	No
62	No	No	No	No	No	No	No	No
63	Yes	No	No	No	No	No	No	No
64	No	No	No	No	No	No	No	No
65	Professor+of	none		a+member+of+a+professional+		urban+researcher	TEST	
66	2	1	1	1	1	1	1	1
67								
68								

	L	M	N	O	P	Q	R
3	e.durmisev	Sanja+Durm	Janneke+Arkeste	Predrag+Sid	alexandar+	jan+sirius+albreht	Vera+Vujacic
4	e.durmisev	s.durmisevic	j.n.mosterd@bk.t	p.sidjanin%4	cbeer%40E	sirius1%40casema.	taraarts%40a
5	researcher	architect	secretary	architect	graphical+d	photographer	psychologist
6	31	30	+or+towns%2C+y	46	47	36	51
7							
8							
9	5	5	2	5	5	5	5
10	5	5	3	5	5	5	5
11	4	5	3	5	5	5	5
12	5	4	1	5	5	5	5
13							
14	5	5	2	5	4	5	5
15	5	5	3	5	5	5	5
16	5	5	3	5	5	5	5
17	4	5	1	5	4	5	5
18	4	2	3	5	4	5	5
19	5	4	3	5	5	5	5
20							
21	5	5	1	5	4	4	5
22	5	5	2	5	3	4	5
23							
24	4	5	3	5	5	4	5
25	5	5	3	5	4	4	5
26	3	3	3	4	3	4	5
27	4	5	3	3	4	4	4
28	5	5	2	5	5	4	4
29							
30	5	5	3	5	5	3	4
31	5	4	2	4	4	3	5
32	4	5	2	5	3	3	4
33							
34							
35	3	4	2	5	5	3	5
36	x	5	3	5	4	3	5
37	3	4	2	4	3	3	4
38	5	5	3	4	4	4	4
39	4	5	3	4	5	4	5
40	5	5	2	5	4	4	5
41	4	5	3	5	3	3	4
42	4	5	2	5	4	3	4
43	5	4	2	5	5	3	3
44	5	5	2	5	4	5	3
45							
46	4	5	2	4	5	4	5
47	4	5	2	5	5	4	5
48	3	5	2	5	3	5	5
49	5	5	2	4	5	4	5
50	5	5	2	4	5	4	5
51							
52	4	3	2	5	5	5	5
53	5	5	3	5	4	5	5
54	4	5	2	4	4	5	5
55	5	5	5	4	5	5	5
56							
57	1	1	1	2	2	2	1
58							
59	Yes	Yes	Yes	Yes	Yes	Yes	Yes
60	No	No	Yes	Yes	Yes	Yes	Yes
61	No	No	No	No	No	No	Yes
62	No	No	No	No	No	No	No
63	No	No	No	No	No	Yes	No
64	No	No	No	No	No	No	No
65							
66	1	1	1	1	1	2	2

	S	T	U	V	W	X	Y
3	Mart+Tacken	Maarten+Piek	Lidija+Poth	milenko+grga	Hugo+Gordijn	rene Luyk	max van steen
4	m.h.h.k.tacker	M.piek@bk.tud	l.poth@bk.t	milenko%40i	hgordijn%40ca	rene@wat	m.c.vansteen%
5	senior+resear	student+%28st	student	movi+directo	research+coor	ICT	student
6	61	29	31	48	50	29	28
7							
8							
9	4	5	5	4	5	5	5
10	4	5	5	4	5	4	5
11	4	5	5	4	5	5	5
12	3	5	5	3	4	4	5
13							
14	4	5	5	4	5	5	5
15	4	5	5	4	5	5	5
16	4	5	4	4	5	5	5
17	4	5	4	4	5	5	5
18	3	3	4	4	4	4	3
19	4	4	4	4	4	5	3
20							
21	3	4	5	4	4	3	4
22	3	3	3	3	4	4	2
23							
24	4	3	4	4	4	3	3
25	2	3	3	3	4	3	4
26	3	2	3	2	2	3	3
27	3	4	5	2	4	5	4
28	4	5	5	3	4	3	4
29							
30	4	4	5	3	5	5	5
31	3	5	3	3	5	5	5
32	4	5	3	3	4	2	3
33							
34							
35	2	4	3	3	2	3	2
36	3	3	3	2	3	2	2
37	2	4	3	3	2	2	3
38	2	4	4	2	2	3	4
39	3	3	4	4	3	4	4
40	3	4	5	2	4	5	4
41	3	3	3	3	5	1	4
42	2	3	4	3	3	3	4
43	2	4	3	3	4	5	4
44	1	5	5	2	4	4	3
45							
46	3	3	3	3	2	4	5
47	2	4	4	3	4	3	4
48	2	4	4	2	4	3	5
49	2	3	5	1	5	4	3
50	1	4	3	2	5	3	4
51							
52	1	4	4	3	2	4	4
53	3	4	4	4	5	5	3
54	3	4	3	2	5	5	4
55	5	5	5	1	4	1	1
56							
57	2	2	1	2	2	2	2
58							
59	Yes	Yes	Yes	Yes	No	No	No
60	Yes	Yes	Yes	Yes	No	No	Yes
61	No	No	No	No	No	No	No
62	No	No	No	No	No	No	No
63	Yes	No	No	No	Yes	No	No
64	No	No	No	No	No	No	No
65	researcher	studies	student+of+architecture				
66	1	1	1	2	1	1	1

	Z	AA	AB
3	A.+van+Mispela	marjoke+roorda-	olga+van+
4	ACM.vanmispel	marroo%40vpro.	o.vanmaar
5	student	radioprogramma	urban+des
6	24	49	26
7			
8			
9	5	2	4
10	5	2	5
11	5	2	4
12	5	1	4
13			
14	5	2	3
15	5	1	3
16	4	2	3
17	4	3	4
18	5	2	4
19	5	1	4
20			
21	5	2	3
22	5	2	3
23			
24	3	5	4
25	3	5	4
26	4	4	4
27	4	3	4
28	4	4	3
29			
30	4	5	4
31	5	4	3
32	5	4	4
33			
34			
35	3	4	3
36	4	4	3
37	4	3	2
38	4	3	3
39	4	1	4
40	3	5	4
41	3	3	3
42	3	4	4
43	3	3	3
44	4	4	4
45			
46	4	2	3
47	3	2	3
48	4	3	4
49	3	4	4
50	3	4	3
51			
52	3	4	3
53	4	2	4
54	4	3	4
55	5	1	3
56			
57	1	1	1
58			
59	Yes	Yes	No
60	Yes	Yes	No
61	No	Yes	No
62	No	No	No
63	No	Yes	No
64	No	No	No
65	a+planner	media	
66	1	1	1

Table 4. Overview of the results per question

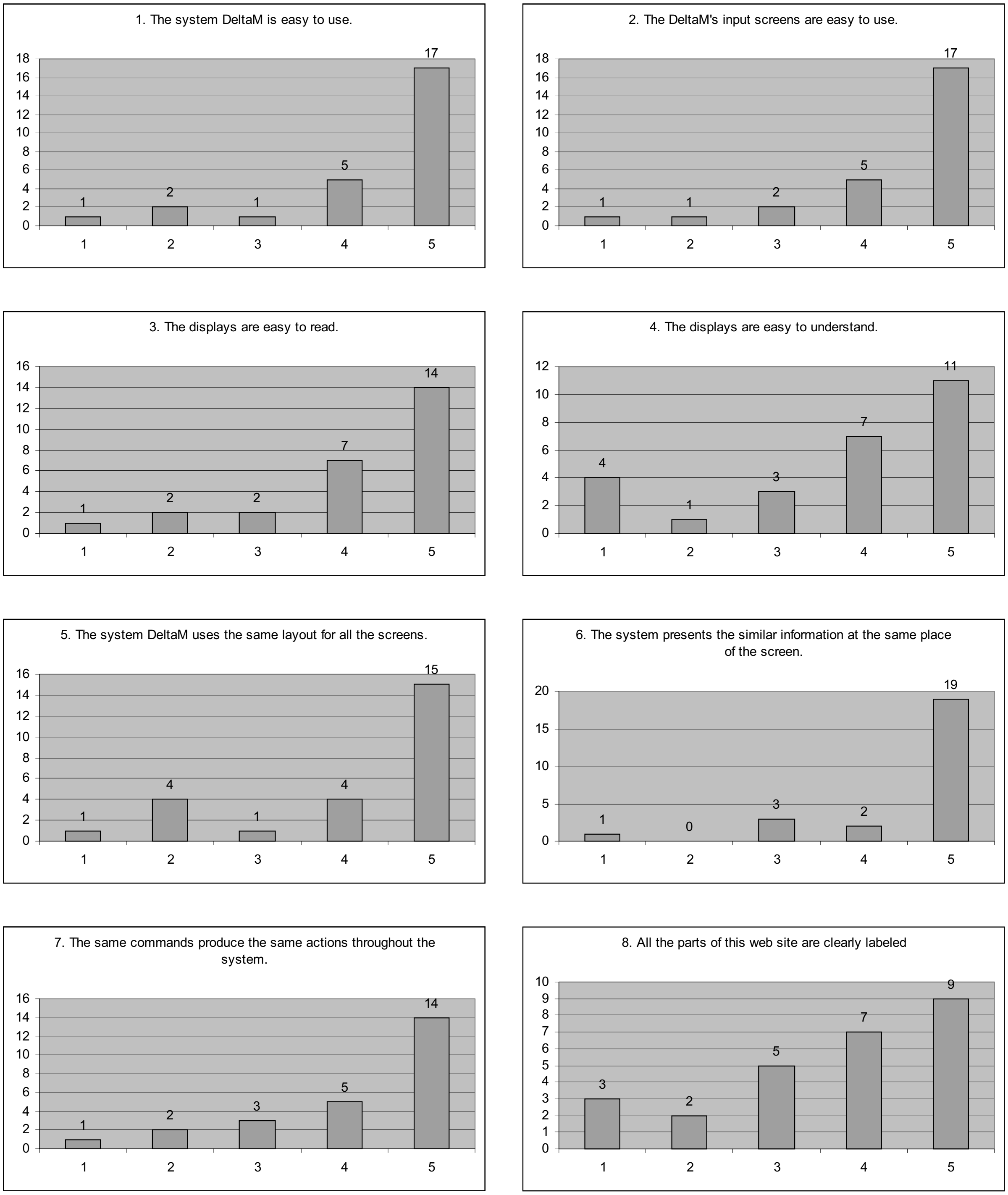
	Question	1	2	3	4	5
A1	1. The system DeltaM is easy to use.	1	2	1	5	17
A2	2. The DeltaM's input screens are easy to use.	1	1	2	5	17
A3	3. The displays are easy to read.	1	2	2	7	14
A4	4. The displays are easy to understand.	4	1	3	7	11
	Consistency					
A5	5. The system DeltaM uses the same layout for all the screens.	1	4	1	4	15
A6	6. The system presents the similar information at the same place of the screen.	1	0	3	2	19
A7	7. The same commands produce the same actions throughout the system.	1	2	3	5	14
A8	8. All the parts of this web site are clearly labelled	3	2	5	7	9
A9	9. This web site is presented in an attractive way	0	5	7	9	5
A10	10. I enjoy the experience of using this web site	2	2	4	10	8
	Control					
A11	11. Going from one part to another is easy on this web site	2	1	6	8	9
A12	12. I feel in control when I'm using this web site	1	3	8	7	7
	Efficiency					
A13	13. Completing task to choose a project using the DeltaM is faster then current procedures.	1	0	9	9	6
A14	14. It is easier to chose a project using the DeltaM that with current procedures.	0	1	12	5	6
A15	15. The suggested list of projects meets my needs	1	4	14	5	1
A16	16. I would feel comfortable using DeltaM under the time pressure	1	1	8	10	5
A17	17. The response time is fast enough to keep me interested	1	2	5	10	8
	Learnability					
A18	18. The system DeltaM requires no training for infrequent users.	2	1	4	6	13
A19	19. All the material is presented in a way that is easy to understand.	2	2	6	8	8
A20	20. The system has enough help features.	3	3	7	8	4
	Empirical evaluation					
	Process Quality					
B21	21. I agree with the list of questions that are put to me	1	5	10	3	5
B22	22. I agree with the scoring system applied for the classification of projects	2	4	11	3	3
B23	23. I have enough data to decide whether I like some project or not.	3	9	9	5	0
B24	24. The system DeltaM is using right data to inform user about projects.	1	4	8	9	2
B25	25. The visual presentation of data is good.	2	2	7	10	5

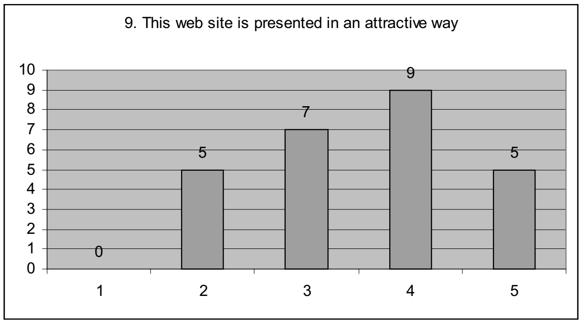
B26	26. I agree with the matrix that DM uses to present the projects.	1	2	5	7	9
B27	27. The system DM uses logically sound approach to support user in selecting preferable projects among many.	4	1	11	5	4
B28	28. The system DM contains an adequate level of expertise to support users performing selection of projects	1	3	8	9	3
B29	29. The system allows users to examine expertise on which systems' recommendation is based.	4	2	9	5	5
B30	30. The system contains familiar terms.	2	2	5	7	10
	Product quality					
B31	31. Overall, the system DM provided me with useful results.	1	4	9	7	4
B32	32. Overall, the reasoning underlying the results is acceptable	0	5	6	8	4
B33	33. It is easy to interpret the results of the DM.	1	4	5	9	6
B34	34. It was easy to form a mental picture of how the system DM works.	3	3	5	7	8
B35	35. It was easy to understand why the results came out the way they did.	3	3	8	6	6
	Overall confidence					
B36	36. I have a lot of confidence in the results obtained working with DM	3	3	5	9	5
B37	37. I am confident that DM is well built technically.	0	2	6	7	10
B38	38. I have a lot of confidence in the DM's approach in quich selection among many projects.	3	2	4	10	7
B39	39. I was not influenced by the opinion of other participants shown in the statistics next to the answers	6	0	2	6	12
	Participants					
P43	43. Your sex	13	13			
P46	46. How experienced internet user you are?	22	4	0		

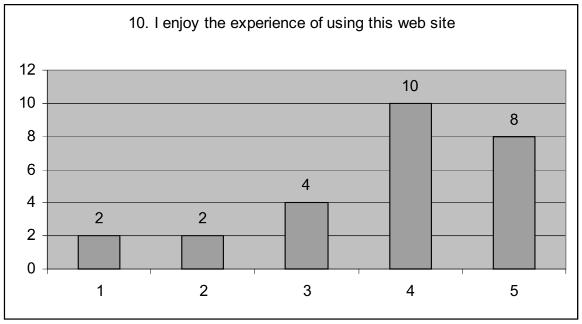
1 female, 2 male
1 a lot, 2 sometimes, 3 never

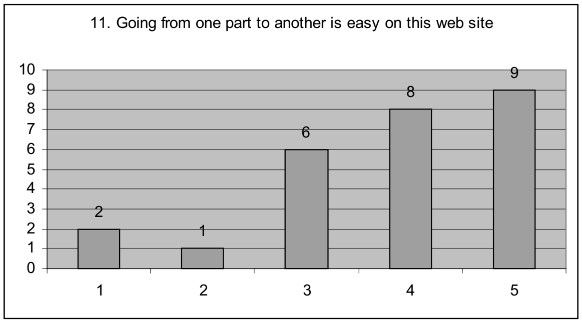
1 completely disagree
5 completely agree
3 neither agree nor disagree

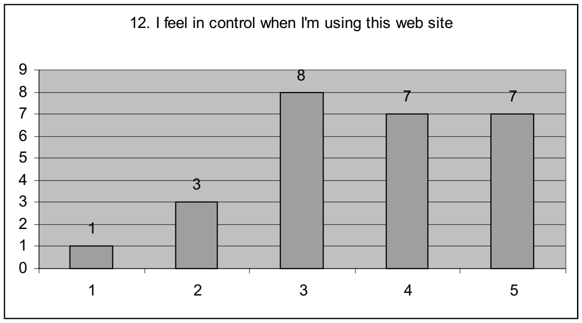
Graph 1. Overview of the results of usability testing and empirical evaluation. Total number of respondents is 26.

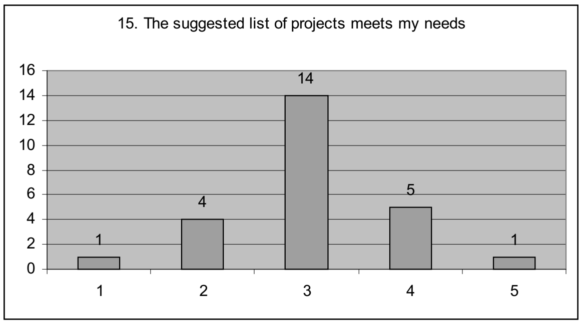


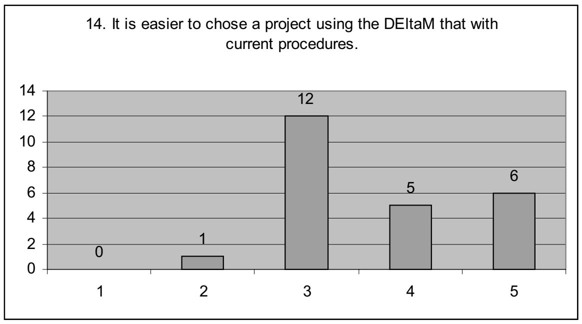

9. This web site is presented in an attractive way
0
5
7
9
5
1 2 3 4 5

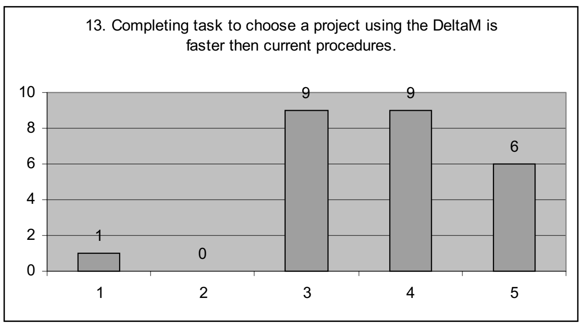

10. I enjoy the experience of using this web site
2
2
4
10
8
1 2 3 4 5

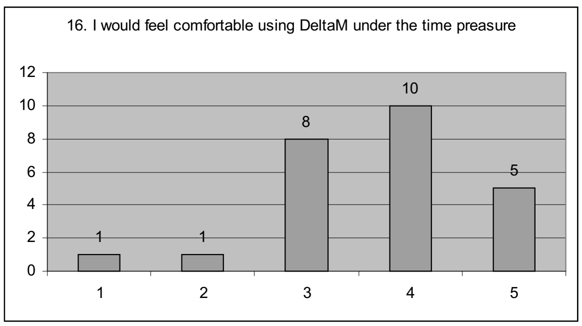

11. Going from one part to another is easy on this web site
2
1
6
8
9
1 2 3 4 5

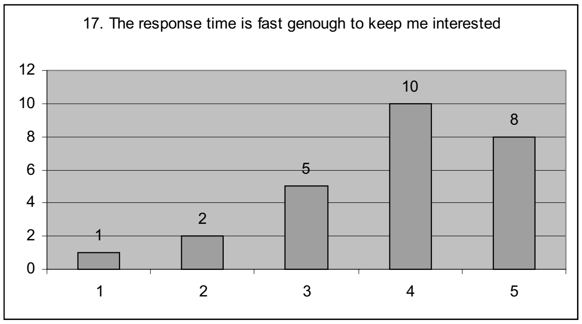

12. I feel in control when I'm using this web site
1
3
8
7
7
1 2 3 4 5

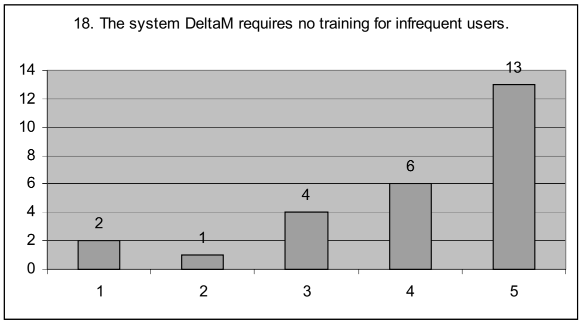

15. The suggested list of projects meets my needs
1
4
14
5
1
1 2 3 4 5

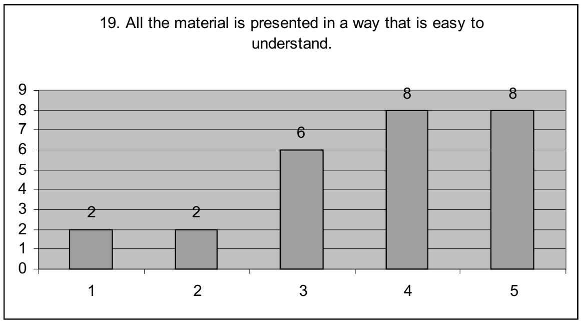

14. It is easier to chose a project using the DEltaM that with current procedures.
0
1
12
5
6
1 2 3 4 5

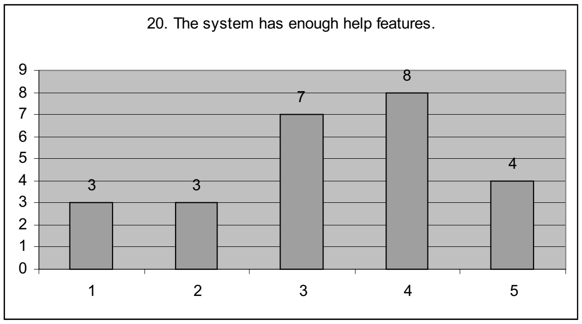

13. Completing task to choose a project using the DeltaM is faster then current procedures.
1
0
9
9
6
1 2 3 4 5

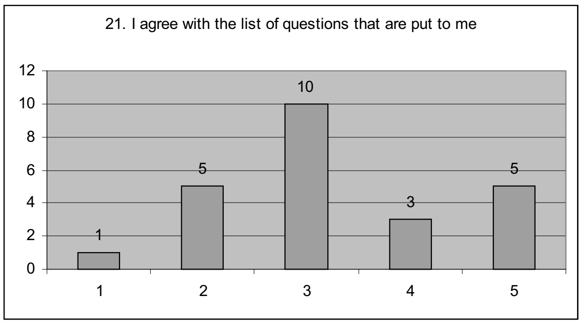

16. I would feel comfortable using DeltaM under the time preasure
1
1
8
10
5
1 2 3 4 5

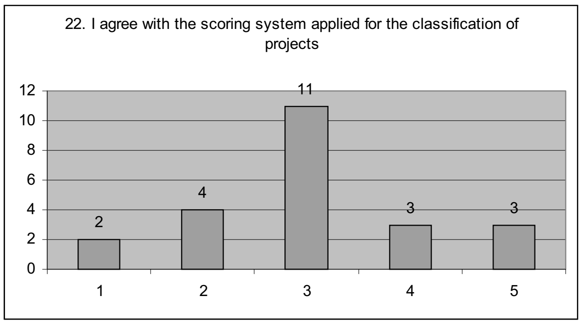

17. The response time is fast genough to keep me interested
0 2 4 6 8 10 12
1 2 5 10 8
1 2 3 4 5

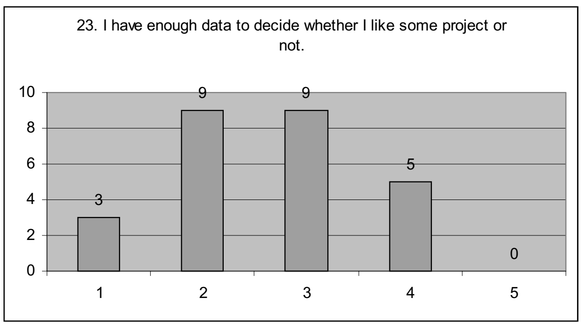

18. The system DeltaM requires no training for infrequent users.
0 2 4 6 8 10 12 14
2 1 4 6 13
1 2 3 4 5

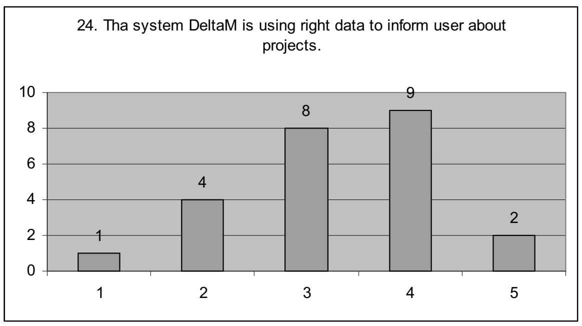

19. All the material is presented in a way that is easy to understand.
0 1 2 3 4 5 6 7 8 9
2 2 6 8 8
1 2 3 4 5

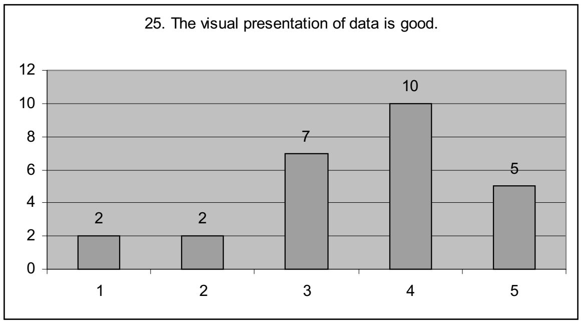

20. The system has enough help features.
0 1 2 3 4 5 6 7 8 9
3 3 7 8 4
1 2 3 4 5


21. I agree with the list of questions that are put to me
0 2 4 6 8 10 12
1 5 10 3 5
1 2 3 4 5

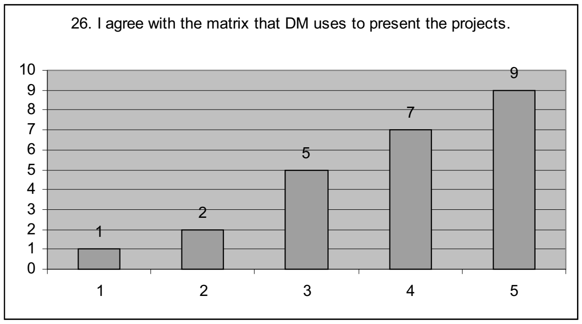

22. I agree with the scoring system applied for the classification of projects
0 2 4 6 8 10 12
2 4 11 3 3
1 2 3 4 5


23. I have enough data to decide whether I like some project or not.
0 2 4 6 8 10
3 9 9 5 0
1 2 3 4 5

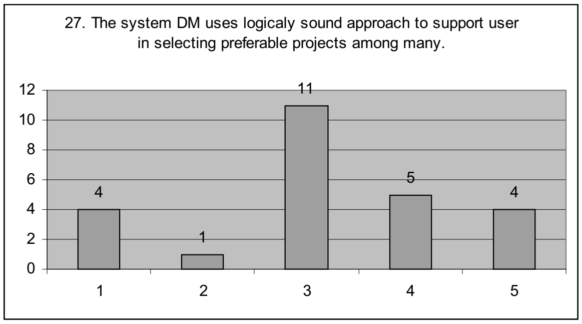

24. Tha system DeltaM is using right data to inform user about projects.
0 2 4 6 8 10
1 4 8 9 2
1 2 3 4 5



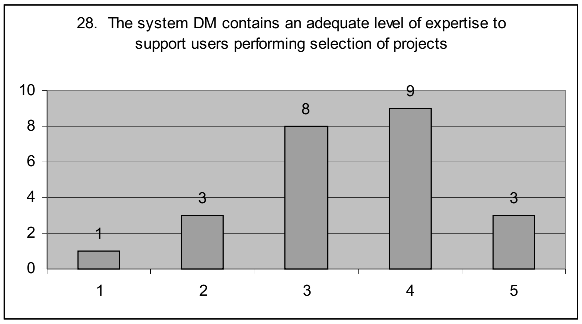
25. The visual presentation of data is good.



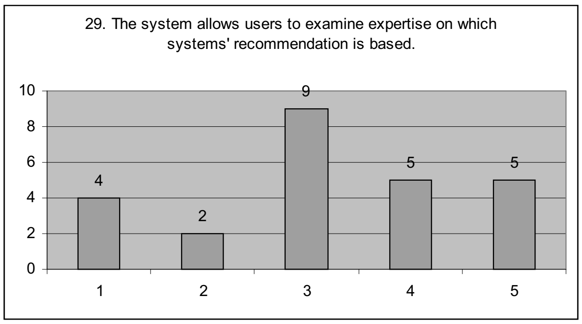
26. I agree with the matrix that DM uses to present the projects.



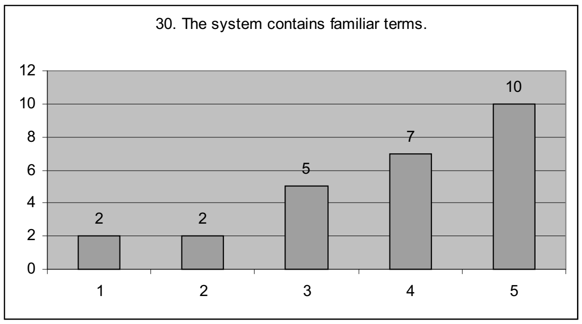
27. The system DM uses logicaly sound approach to support user in selecting preferable projects among many.



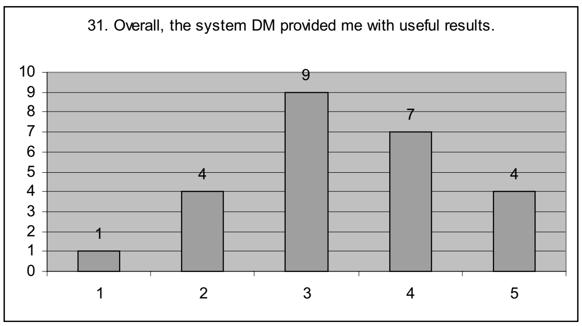
28. The system DM contains an adequate level of expertise to support users performing selection of projects



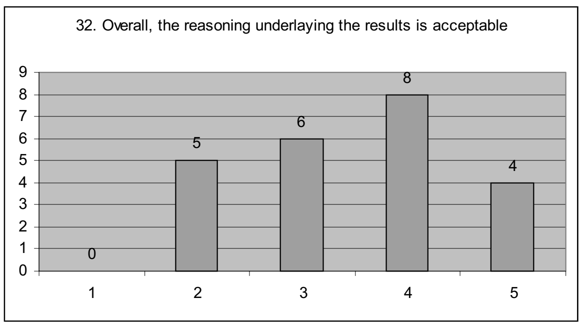
29. The system allows users to examine expertise on which systems' recommendation is based.



30. The system contains familiar terms.

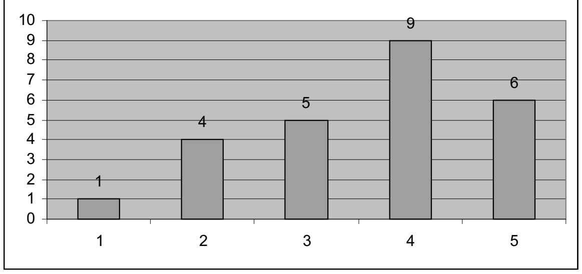


31. Overall, the system DM provided me with useful results.

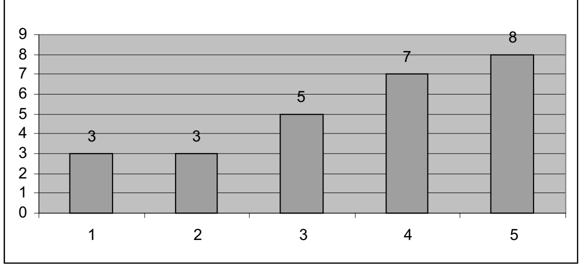


32. Overall, the reasoning underlaying the results is acceptable

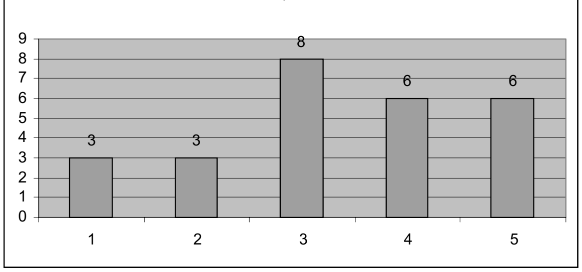
33. It is easy to interpret the results of the DM.



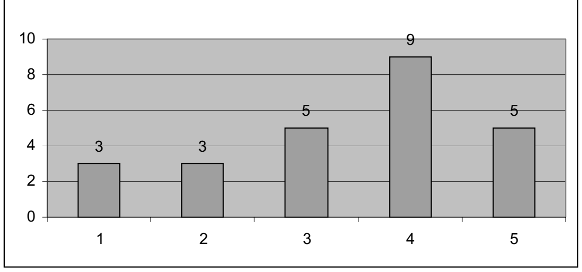
34. It was easy to form a mental picture of how the system DM works.



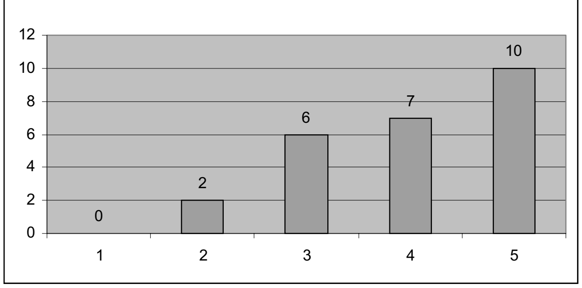
35. It was easy to understand why the results came out the way they did.



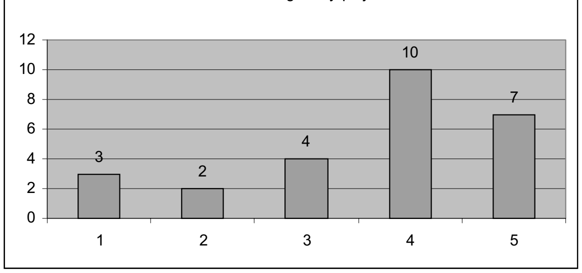
36. I have a lot of confidence in the results obtained working with DM



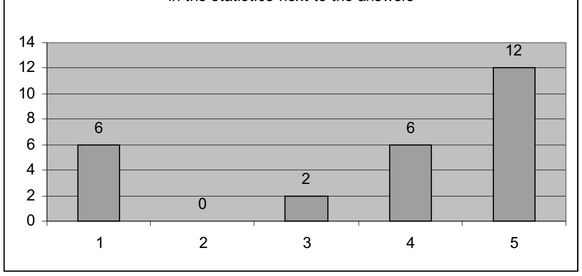
37. I am confident that DM is well built technically.



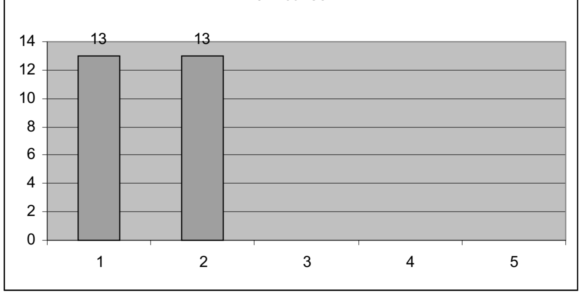
38. I have a lot of confidence in the DM's approach in quich selection among many projects.



39. I was not influenced by the opinion of other participants shown in the statistics next to the answers



43. Your sex



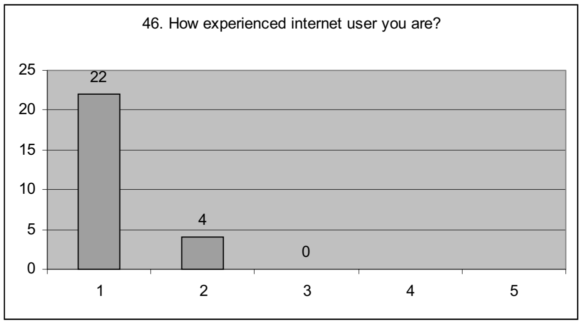

46. How experienced internet user you are?
25
20
15
10
5
0
22
4
0
1
2
3
4
5

Table 5. Comments of respondents

Question	Respondent	Comment
A1	Andre Dantas	
	Donna Luckey	
	Peter de Jong	
	Teisman	
	K. Moraes Zarzar	
	Perica Savanovic	
	A.M. Feranandez-Maldonado	
	Latifa Chouider	
	Alinta Thornton	
	E.Durmisevic	
	Sanja Durmisevic	
	Janneke Arkesteijn	
	Predrag Sidjanin	
	Alexandar Pedovic	
	Jan Sirius Albreht	
	Vera Vujacic	
	Mart Tacken	
	Maarten Piek	
	Lidija Poth	
	Milenko Grgar	
	Hugo Gordijn	
	Rene Luyk	
	Max van Steen	
	A. van Mispelaar	
	Marjoke Roorda van Eysinga	
	Olgavan Maanen	
A2	Alinta Thornton	Had little idea why I was clicking on anything. I chose one at random and got a very slow to download screen which told me little and gave me no idea what to do next.
A3	Donna Luckey	black background is too strong soften to navy or dark green
	LatifaChouider	Depend of screen resolution don't see complete window at 800x600
	Alinta Thornton	Way too small sideways black background.
A4	Andre Dantas	After the questions answers a new page is displayed but nothing is explained about that.
	Latifa Chouider	In some parts I am guided and in others i feel lost
	Alinta Thornton	See above. Why do you need the great big graphics on the first screen They play no part in my decision making about what to click on. They are meaningless to me.
	Sanja Durmisevic	Sometimes I would prefer to choose more than one option for example care and recreation.
	Janneke Arkesteijn	see 1
A5	Donna Luckey	some allowed multiple answers I wanted all to allow this. . .
	Alinta Thornton	Don't know did not get that far.

A6	Alinta Thornton	Too irritating to find out.
A7	Andre Dantas	the final page leads to the matrix images that does not mean anything to me.
	Latifa Chouider	no maybe its because its not complete yet projects part
	Alinta Thornton	
A8	Andre Dantas	I do not understand Dutch
	Donna Luckey	the final screen in Dutch with ranking was not as clear as others
	Latifa Chouider	not the conclusion part
	Alinta Thornton	NO
	Janneke Arkesteijn	especially the last item was very unclear to me
A9	Donna Luckey	see comment above re. black background but given black yes.
	Alinta Thornton	I have a dislike of black backgrounds.
	Sanja Durmisevic	some illustrations would be nice as a feedback for options
	Janneke Arkesteijn	it is flashing too much
A10	Donna Luckey	yes but again the issue of multiple answers not always possible was frustrating.
	Alinta Thornton	Very frustrating.
	Janneke Arkesteijn	see 9
	Predrag Sidjanin	very nice
	Marjoke Roorda van Eysinga	after some try and err
A11	Donna Luckey	but I only used Back and links would be interesting
	AlintaThornton	On the second screen I got a map of a part of the city and no navigation at all. I had to go back and wait all over again for the really slow page to reload. Grr.
	Janneke Arkesteijn	i wanted to go back to the info but I could not
A12	Donna Luckey	same as 11
	AlintaThornton	Its so linear I have little choice other than on first page.
A13	K. Moraes Zarzar	I don’t know
	Latifa Chouider	i don’t know current procedures
	Alinta Thornton	What task. Not clear what that is.
	Janneke Arkesteijn	have no experience with these kind of projects
A14	K. Moraes Zarzar	I don’t know
	Latifa Chouider	i don’t know current procedures
	Alinta Thornton	Have no info on current.
	Janneke Arkesteijn	see 13
A15	Latifa Chouider	this is the part where i am lost
	Alinta Thornton	I’m not a citizen so have no needs.
	Sanja Durmisevic	about
	Janneke Arkesteijn	see 13
A16	Alinta Thornton	No way.
	Janneke Arkesteijn	see 13
A17	Latifa Chouider	not when I am exploring the projects avg.ranking
	Alinta Thornton	Got to be kidding me.

	Janneke Arkesteijn	see 13
A18	K. Moraes Zarzar	depending of how the tool will be used. For a layman the judgement of the projects based on the photos and information given can be too complicated
A19	K. Moraes Zarzar	Depending of who
	Latifa Chouider	the maps are very clear the few that i saw
A20	K. Moraes Zarzar	I do not know
	Latifa Chouider	when i was lost i had no help
	Alinta Thornton	If it's a good design you don't need any.
B21	Donna Luckey	broad general and therefore limited. A choice to go in-depth would have been nice to allow US to show areas of stronger interest
	A.M. Feranandez-Maldonado	yes but I think more questions are needed
	Alinta Thornton	What questions. Did not find any. How can I agree with questions
	Sanja Durmisevic	perhaps some additional questions could be later added
B22	K. Moraes Zarzar	I don't know how it is calculated...
	A.M. Feranandez-Maldonado	I cannot evaluate this
	Latifa Chouider	this part was unclear for me
	Alinta Thornton	Did not find a scoring system.
B23	K. Moraes Zarzar	It should be nice to have a set of advantages disadvantages card according to the users answers
	A.M. Feranandez-Maldonado	Zuid As was good Superbia too little information
	Latifa Chouider	this part was unclear for me
B24	K. Moraes Zarzar	is right consistent essential or correct data
	Latifa Chouider	something is missing maybe some text …
	Alinta+Thornton	May well be but I don't know what this really means.
B25	A.M. Feranandez-Maldonado	the matrix attracts too much attention at first i did not realise that there was more information clicking on the title
	Janneke Arkesteijn	too much information
B26	A.M. Feranandez-Maldonado	it is orderly but I would put more variables to make it more useful
	Alinta Thornton	This is a silly question. You can agree but still not be able to use it.
B27	Donna Luckey	I don't see that it was clear what projects were selected or avail. to select
	Latifa Chouider	Sound
	Alinta Thornton	I suppose you mean the questions at the beginning Because I had no context for the questions I answered them willy nilly with little thought and have no idea what you were using them for.
	Janneke Arkesteijn	my sound was off
B28	K. Moraes Zarzar	the projects are very different from each other... if one is more interested on housing he she should be able to select only

		housing it would be also easier for the program which would only calculated the performance of the required kind of project
	Latifa Chouider	Sure
	Alinta Thornton	Cant tell.
B29	A.M. Feranandez-Maldonado	this is not so clear
	Alinta Thornton	No
B30	Alinta Thornton	No. Mind you there is a big Dutch section under more info.. perhaps that where all the good stuff was but I don't speak Dutch. Even there the start page was active while on the start page.
B31	Alinta Thornton	I am guessing I was meant to choose something design wise but did not get to do it.. did not find it.
	Sanja Durmisevic	within the scope of the offered projects
B32	K. Moraes Zarzar	I needed more time and more projects to evaluate that
B33	Alinta Thornton	
B34		
B35	A.M. Feranandez-Maldonado	I did it two time with different responses and I got the same two projects... still it is easy to understand the logic of the tool maybe more projects are needed
	Alinta Thornton	What results.
B36		
B37	Alinta Thornton	Would be higher since everything worked but general attitude to site is so low this pulls down the rating.
B38		
B39	Donna Luckey	Hard to believe this could be true for anyone sometimes I was aware I was not the norm and still I read them.
	Latifa Chouider	a little bit...

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Web site of the workshop with students on 7 March 2000
http://www.bk.tudelft.nl/ai/deltametropool/TOOLS/Events/Workshop7maart.htm.

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About the Author

Aleksandra Tisma was born in Novi Sad, Yugoslavia in 1956. She obtained her diploma of Graduate Engineer of Agriculture, specialization in Landscape Architecture, in July 1980 at the Faculty of Agriculture, University of Novi Sad. She obtained her diploma of Master of Technological Design in January 1995 at the Delft University of Technology.

From 1981 to 1984 she has worked as a research assistant on The Department for Plant Physiology, Faculty of Agriculture, University of Novi Sad. She performed research on different projects and teaching in the undergraduate education.

From 1984 to 1991 she worked as a senior planning-specialist at the Department for Scientific Research and Informatics of the "Institute of Town Planning of Vojvodina", Novi Sad. Her activities concerned landscape and land use planning. As a part of an interdisciplinary team, she took part in the design of a number of spatial plans for the cities, municipalities and provinces of Vojvodina and Kosovo.

From 1992 to 2001 she has been working as a researcher at the Department for Urban Design of the Faculty of Architecture in Delft. Firstly she worked as a AIO, at the OPB and in 1995 completed her master's thesis with the title: ' A GIS-based study; possibilities for new estates in West Brabant'. After that she worked on the multimedia project "Cyberland" and educational blok "Regio". In 1995 and 1996 she worked as a secretary of the constitutional board of the "Research School for Design and Computation". From 1996 till 2000 she has been working as a Ph.D. candidate (*'promovenda'*) and as one of the mentors of the design studio "Deltametropolis".

At the moment she works as a staff member of the foundation "The New Map of the Netherlands".