Progress in Design & Decision Support Systems in Architecture and Urban Planning

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PREFACE

It has been a real pleasure to work with the authors of the papers in this volume; they have contributed with interesting reports on relevant and innovative research projects, which allowed us to compose an inspiring book. Our gratitude goes also to the members of the international scientific committee for their invaluable effort in reviewing and editing these works. Special thanks also go to our colleagues Mandy van de Sande, Marlyn Aretz, and Leo van Veghel, who took great responsibility in organising the practical aspects of the DDSS conference and made it a pleasant and fruitful event.

Eindhoven, July 2006

Jos van Leeuwen and Harry Timmermans
Editors and conference chairs

INTERNATIONAL SCIENTIFIC COMMITTEE

INTRODUCTION

The International Conference on Design & Decision Support Systems in Architecture and Urban Planning is organised bi-annually by the Eindhoven University of Technology. This volume contains a selection of papers presented at the eighth conference that was held at the Kapellerput Conference Centre in the village of Heeze, near Eindhoven, The Netherlands, from 4 to 7 July, 2006.

Traditionally, the DDSS conferences aim to be a platform for both starting and experienced researchers who focus on the development and application of computer support in the areas of urban planning and architectural design. This results in an interesting mix of well-established research projects and first explorations. It also leads to a very valuable cross-over of theories, methods, and technologies for support systems in the two different areas, architecture and urban planning.

This volume contains 27 papers from this year's conference. It is accompanied by the volume *Innovations in Design & Decision Support Systems in Architecture and Urban Planning* from the same editors, published by Springer, which contains another 31 papers from the conference.

This volume is organised into seven sections. Section one of this volume contains four chapters on activity modelling and transportation modelling. Section two has four chapters on micro-simulation. The third section is on multi-agent models, also with four chapters. Section four presents four chapters on public participation. The fifth section contains five chapters on collaborative design. The sixth section is short, containing two chapters discussing virtual environments. The seventh and final section contains four chapters that discuss design research and the development of design support.

The following paragraphs provide a brief summary of the seven sections of this volume.

Activity-Based Models and Transportation Models

Recently, the so-called activity-based approach has received a lot of attention in transportation planning and land use planning. This approach is based on the premise that transport is a derivative of people's needs and desire to conduct activities. A lot of progress has been made lately, but still the approach needs further elaboration in several ways. One of these areas is improved data collection. *Petri, Lapucci, Poletti, & Lombardo* discuss the use of the Internet and geographical information systems to collect and store

data on activity-travel diaries. Their study conducted in Pisa, Italy illustrates the usefulness of this technology in the context of activity-based modelling.

Most existing activity-based models of transport demand are based on the individual as a unit of decision making. However, resource allocation, joint activity participation and task allocation decisions typically involve the household. *Anggraini, Timmermans & Arentze* discuss some key principles of how household decision making can be incorporated into the Albatross model. Such extension will further improve the sensitivity of the model for interdependencies at the household level.

In addition to the literature on activity-based models of transport demand, there is a related literature on integrated land use – transportation models. Originally, these models were founded on home-based discrete choice models, but it has been realised that different approaches are required to cope with new planning practice and complexity of society. *te Brömmelstroet* argues that planning support systems can provide an answer. Preliminary results of the first steps towards such a PSS are presented and a qualitative assessment on the strengths and weaknesses of two recently developed instruments that share this goal (VPR and SDS+STE) is made. *Borri, Circella, Ottomanelli & Sassanelli* discuss the usefulness of choice models in assisting planners in the development of transport policies and interventions for strategic transport planning for urban systems as part of a decision support system for the development of transport measures for sustainable mobility.

Micro-Simulation Models

Small area estimation and spatial micro-simulation methods play an important role in some of these integrated models. However, these approaches certainly have a much wider applicability. This is nicely illustrated by *Tiglao*, who discusses the application of these approaches to the problem of geographical targeting, in this case for poverty alleviation.

A central concept in this line of research is the concept of accessibility. The configuration of land use is assumed to be heavily influenced by differential accessibility. Although called integration in space syntax, these approaches have a lot in common. This is also evidenced by *Pinelo* who reports the results of an accessibility analysis for various types of functions in Lisbon based on the concept of topological accessibility. Accessibility is an important factor influencing many types of spatial choice behaviour. *Borgers, Smeets, Kemperman & Timmermans* report the results of an application of a discrete choice model to predict pedestrian choice behaviour at the micro-scale. Accessibility/location based variables turn out to be

important in predicting pedestrian choices. However, results also indicate that in addition attraction variables are significant.

At the building level, *Tabak & de Vries* present an approach to capture human behaviour in order to simulate the functioning of, for example, an organisation in an office building. To capture the human behaviour they have performed a case study using Radio Frequency Identification (RFID) tags to track individuals' behaviour. The resulting data is combined with the subjects' task descriptions and personal calendar data.

Multi-Agent Models

In terms of modelling approach, a research frontier here is to develop multi-agent models, where each agent represents a particular land use. In this book, we have several papers that fit into this stream of research. *Arentze, Borgers & Timmermans* propose a heuristic method for generating land use plan alternatives under conditions of uncertainty about other land uses. This problem is important and typically not considered in the context of integrated land use transportation models that aim at predicting future land use and mobility patterns, but also for planning support systems that assist in plan development. *Ma, Arentze, Borgers & Timmermans* discuss an application of this approach for a retail and housing agent.

Shen, Kawakami & Chen also propose an interesting multi-agent system for shopping centre development. A random utility model of household shopping behaviour is linked to a decision table formalism simulating location choice of developers. The system is illustrated for a few scenarios.

Devisch, Arentze, Borgers & Timmermans discuss an agent-based model of residential choice processes. It incorporates a process representation of the various stages of finding a new house and describes the negotiation process of a real estate agent and a buying household. Because the utility of a new house is influenced by the utility of activity-travel patterns, their approach is potentially valuable in integrated land use transportation modelling.

Public Participation in Planning and Design

While traditionally, planning support systems have primarily been developed for professionals, increasingly these tools are also developed and applied in the context of public participation. *Kawakami & Shen* describe an interesting case study about the application of a system for public participation at the local planning level in Japan. The system was received well and proved its usefulness. Another interesting case study is reported by *Yamaguchi, Kobayashi & Hibata*. Their study focuses on Yamato City, Japan. Four different channels of communication were used: real meeting and cyber

meetings, with and without restricted membership. Experiences with these different cases are reported. The project UrbanLab, reported by *Caneparo, Guerra & Masala*, develops a platform for urban and regional design. This platform accommodates the complexity of design, considering the dynamics of time and scale as well as recognising the multitude of different actors in the design process. To achieve this, the researchers have applied a combination of cellular automata and multi-agent systems.

A different kind of participation is present in the work done in the VILLAS project by *Di Giulio, Coccagna & Tonelli*. The tools developed in this project aim to support decision-making on the preservation of architectural heritage. The basis for the decision-making is formed by a large data collection representing people's preferences regarding building features and possible reusage of buildings. A GIS web environment is used to collect the various tools and data sources in the project and to provide public access.

Collaborative Design

The first paper in the section of Collaborative Design is not from the areas of Architecture and Urban Planning. *Lee & Liu* present the development of a Groupware / Knowledge Management system that was developed to support the complex collaborative process of notebook design. Their system combines knowledge warehouse technology with a multi-agent system to facilitate the communication between the various stakeholders and to support decision-making. Although the stakeholders in this industrial design process have a different kind of expertise, their ways of communication and approach to decision-making bear much resemblance to those found in the architectural arena.

An essential part of the design process is the communication between designer and client. *Huang & Wang* propose to use large displays or immersive environments to facilitate this communication and to give the client an optimum insight in the qualities of a design. They first analyse and discuss a number of existing techniques for virtual environments and large-scale displays. Then a prototype system is presented that combines an oversized display with gesture recognition to allow for intuitive command of the design space.

In the development of computer support for collaborative work, much attention has gone to the sharing of documents and resources. *Deshpande, de Vries & van Leeuwen* recognise the importance of discourse in design team meetings and the objective of achieving a shared understanding. The aim of their research is to develop computer support to record the discourse in order to make, e.g., the argumentation available in a structured way. This will allow a design team to identify and work on common objectives and reach

shared understanding. The paper describes the development of experimental prototypes that are used to analyse the requirements of a collaboration workspace.

Targeting the sharing of resources, processes, and information models, *Beetz, van Leeuwen & de Vries* present an analysis of the technologies developed in the semantic web community and discuss how these can be utilised in the development of a multi-agent framework for distributed collaboration. The ultimate goal of this development is to use logic based knowledge representations to enhance and partly automate the communication between real and virtual design partners.

In multi-disciplinary projects, such as those in the construction industry, coordination and decision-making are complex tasks that should involve multiple actors. *Kubicki, Halin & Bignon* propose a tool that assists informal forms of coordination, such as mutual adjustment, in which multiple actors take decisions based on their particular expertise and information from multiple viewpoints. The tool involves a multi-view dashboard-type interface to project information that presents the actors with indicators on activity states in the construction project.

Virtual Environments

Virtual environments are excellent tools to visualise in a most realistic manner the qualities of an architectural design. In this section two related projects from Korea are presented on the construction and evaluation of spatial building models that are rich with information regarding human behaviour and usage of spaces. *Lertlakkhanakul, Do & Choi* acknowledge the fact that, although *space* is the basic element of architectural design, it becomes a meaningful *place* only when there are users and activities in a space. Their research aims to introduce the notion of place into a semantic building model that facilitates architectural design tools. *Han, Choi & Lertlakkhanakul* provide a virtual environment as a test-bed for human behaviour in architectural places. Apart from studying human behaviour, their system also supports designing places from a human-centred perspective.

Design Research & Design Support

According to *Bailey*, the main challenge for architectural design education is to provide students with a base of practical knowledge that allows them to deal with today's rapid technological changes. His answer to this challenge is to use digital means for design education that are developed to meet a high

standard of pedagogical requirements, support multiple learning strategies, and facilitate a rich student-tutor interaction.

Another way of learning in design is by utilisation of experiential knowledge. *Lee & Deng* propose to integrate the TRIZ methodology, which utilises analogies in design problems and design solutions, with techniques of case-based reasoning. The implemented prototype first applies case-based reasoning to converge the solution space that is subsequently processed with the TRIZ methodology to generate innovative solutions.

The two chapters that conclude this section, and this volume, are from Taiwan and offer two methods for integrating physical models into the design process. *Yen* describes the *space cube*, a physical cube that acts as a tangible user interface for digital design tools. The designer's interactions with the physical model are direct input into the digital design process, and vice versa. *Tang* focuses on the production of physical prototypes of design. This work proposes an approach that learns from traditional wood joints and that applies this type of joints in complex three dimensional structures. This methodology describes the qualities of these traditional joints and how to produce those using digital tools and rapid prototyping equipment.

To conclude, the editors are proud to present this book, which provides an interesting range of innovations in design & decision support systems in architecture and urban planning. We hope and expect that this book will continue to function, after the DDSS 2006 conference, as a means to bring researchers together and as a valuable resource for our continuous joint effort to improve the design and planning of our environment.