Lecture Notes in Control and Information Sciences 174

A.J.M. Beulens H.-J. Sebastian (Eds.)

Optimization-Based Computer-Aided Modelling and Design

Proceedings of the First Working Conference of the IFIP TC 7.6 Working Group, The Hague, The Netherlands, 1991

Springer-Verlag

IFIP

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Springer-Verlag
Berlin Heidelberg New York
London Paris Tokyo
Hong Kong Barcelona Budapest

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ISBN 3-540-55135-2 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-55135-2 Springer-Verlag New York Berlin Heidelberg

Typesetting: Camera ready by authors
Offsetprinting: Mercedes-Druck, Berlin; Bookbinding: B. Helm, Berlin
60/3020 5 4 3 2 1 0 Printed on acid-free paper

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Editors: M. Thoma and W. Wyner

Editorial Preface

The world in which we live and in which organisations function seems to become more and more complex. This increased complexity may be caused by changes of the environment in which organisations and people have to function, changes of the organisations, and of the products and services that they produce. Factors that contribute to this complexity include environmental-, and technological factors.
Environmental complexity may be related to market changes, increased legal constraints for organisations, and social and political developments. Market changes include globalization of markets and changes from a sellers to a buyers market with individual and increasing consumer demands. As a result organisations are confronted with increasing requirements with respect to product specifications and service levels, and shorter product life cycles. Increased legal constraints and obligations may be related to product content, packaging and associated information content, transport and storage constraints, and waste and pollution constraints. Last but not least social and political developments result in changes in our society that may affect the way in which people in organisations are able to cooperate and the way in which these organisations are structured and can be managed.
Technological complexity may be related to the effective and efficient use of new and sophisticated production, product, packaging, storage, transport and information technology. The use of complicated technology must enable organisations to reach and serve their markets in a competitive manner. More and more, information technology (IT) and information are considered to be of strategic importance for organizations, in the sense that IT and information are of vital importance for management, communication and primary processes. As a result the need for information systems (IS) with increased capabilities, improved performance and more "intelligence" has grown rapidly over the last decades and it seems that this need is still growing. This holds in particular for specific types of information systems such as model-based decision support systems (MBDSS) and knowledge based decision support systems (KBDSS). These systems are meant to support decision makers in organizations to perform their tasks efficiently and effectively.
The increased need for more sophisticated systems on one side, and the ever improving price/performance ratio of computer systems and software on the other side, have been providing and continue to provide a challenge for researchers in the areas of computer science, information systems, AI, DSS, operations research, decision making, business management, and cognitive psychology. This challenge is to perform research in the theoretical fields that are pertinent for building effective (KB)DSS and applied research concerned with actually building and implementing DSS.

Researchers have not left this challenge unnoticed during the last two decades. A lot of theoretical and applied research has been performed and has been reported about during conferences and in a variety of scientific papers and books. These developments have also lead to the establishment of several scientific working groups whose members share an interest in a number of topics related to (KB)DSS. The IFIP-TC 7 (System Modelling and Optimization) Working Group 7.6 with the working title "Optimization-Based Computer Aided Modelling and Design" (OCAMD) is one of these working groups. It was founded in 1988 and started its work during the 14'th TC 7 General Conference on System Modelling and Optimization. During this conference some special sessions concerned with the topics of interest for the TC 7.6 working group were held.

The first Working Group Conference "OCAMD" of WG 7.6 was organized by and held at the Faculty of Informatics of the Haagse Hogeschool from April 2-4, 1991, The Hague, The Netherlands.

The working conference dealt with recent developments in the field of modelling and optimization, and with knowledge based decision support systems. This contributed to the realization of the aims of the working group. The aims of the working group 7.6 are:

- to promote theoretical research in the field of optimization including mathematical programming and optimal control;
- to encourage the development of sophisticated knowledge based systems in which refined optimization models and algorithms are used;
- to contribute to the exchange and dissemination of information and collective experience among the interested groups and individuals;
- to support the practical application of such systems in control, engineering, industry, economy etc.

The working conference was attended by about 40 scientists, which originated from Czechoslovakia, France, Germany, Great Britain, Hungary, The Netherlands, Switzerland, and the USA. The papers presented during the conference covered a broad range of topics and applications and comprised mainly:

- Computer Aided Design, Manufacturing and Decision Support Systems that contain optimization models; (CAD, CAM, MRP, DSS - theory and applications).
- Computer Aided Modelling and Design of Information and (Knowledge Based) Decision Support Systems;
- Expert Systems using Optimization Based Reasoning;
- Expert Systems for Optimization or Control Problems.

A selection of papers, accepted by the International Program Committee and presented during the Working Conference, are included into this proceedings volume since:

- they are thought to reflect the current state of research in areas of interest to the field of (KB)DSS, and/or
- they are of value for the dissemination and exchange of information related to research topics of interest, and/or
- they describe relevant practical experiences related to designing, building, implementing and using (KB)DSS.

The International Program Committee and the editors of this volume feel that the first working conference of WG 7.6 contributed to the aims of the working group. Further we feel that the conference contributed to generate new ideas about important research topics for the future. This encompasses research in areas such as improved model management, automatic generation of specific DSS, improved methods to design and implement DSS, and the use of different technologies in DSS. We trust that these proceedings will be of value to both researchers and those interested in building applications in the area of (KB)DSS.

The Editors,

Prof. Adrie J.M. Beulens,
Prof. Hans-Jürgen Sebastian

Contents

<u>A decision support system to determine bankhall concepts</u>

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Abstract:

The Rabobank consists of about 900 local cooperative banks which have in total about 2000 branches. These branches are located in different areas with different types of clients. Therefore the bankhall of a Rabobank is not standardized. A bankhall concept in an agricultural area is not the same as in a suburban area. To assess the functions and the organization of a bankhall the Department of Applied Mathematics has developed a simulation model to support decision making on the various bankhall concepts.

The simulation model has two subsystems. The first subsystem is the dialogue system. This system takes care of the communication with the user and the devices. The second subsystem is the simulation model itself.

Building a decision support system is not a guarantee that it will be used to support decisions. There are several aspects which have to be considered before implementing a decision support system. The (end)users must be convinced that the system is a real help in decision making. The problem of data collection and data handling should not be underestimated. The access to the system has to be simple and flexible. And last but not least, the user has to have the knowledge to interpret the results in the right context.

1. Introduction

The Rabobank organization consists of about 900 local cooperative banks which have about 2000 branches. The 900 local banks have founded the cooperation Rabobank Nederland. Rabobank Nederland supports the local banks and handles all the banking activities which cannot be done by a local bank. Because of the cooperative structure of the Rabobank organization the local banks are responsible for their own business. They have their own interest rates policies, commercial policies, human resource development, allocation policy etcetera.
So each local bank is unique.

To support the local banks, Rabobank Nederland uses some standard characterizations based on client segmentation and product segmentation All the decision support systems, which have been developed to support local banks and which are dealing with products and clients are based o these segmentation. Although there is a standard characterization each decision support system has to cope with the specific characteristics, behaviour and policies of the local banks.

One of those systems is a bankhall simulation model. This simulation model can be used to solve processing problems in the bankhall and to support decisions concerning the layout of a new bankhall. The decision are based on workload, number of clients to accommodate and the custome service level.

The bankhall simulation model consists out of two subsystems. The first subsystem is the dialogue system. The dialogue system takes care of the communication between the user and the bankhall simulation model. With this system the user is able to define which data will be used, to modify the data, to define the model, to save data and model and to start the simulation. The second subsystem is the simulation model itself. This model is behind the scene of the user. It is an replicate of the layout of the bankhall under investigation. All the activities, processes, queues etcetera which take place in the bankhall are reproduced within this model.

Implementing a model which is user friendly, can be time consuming. A lot of details have to be taken care of. But implementing a nice system is not a guarantee that it will be used properly by the user or the owner of the system. There are two aspects involved in using the simulation model. In the first place there is a problem of data collection. The systems used at counters nowadays, are not able to present in an adequate way information which is of interest for a simulation model. The other aspect is the user himself. He has to have knowledge of what is going on in the bankhall and how it is simulated.

2. The general bankhall concept

Although each local bank is unique, still there are general aspects in processing clients in a bankhall. By constructing bankhall-elements such as a central cashier, quick cashier, counters, clerks, ATM's, etcetera and by defining standard processes as handling the different types of transactions, it is possible to compose a bankhall.

Each client has at least one transaction and sometimes even more. These transactions can be advice, money transactions, travelling reservations, insurance, etcetera. To handle these transactions a bankhall has to be staffed and equipped with counters, ATM's and computer systems. The transactions can be divided into two groups: the cash transactions and the non-cash transactions. The cash transactions are transactions where value-documents such as money and cheques are involved. These documents are not stored at the counter for security reasons. In general there is a special cash system with a cash-organization somewhere in the building, which is functionally part of the bankhall but physically separated.

There are three main concepts of the cash organization. In the first place there is the clerk's own cash system. This is a special cash system with security provisions and is used only in small bankhalls. A second concept is the central cashier with pipeline connection to the counter. The cashier can sit anywhere in a secured room in the building. The information to and from the cashier is handled by the counter information system and the documents are send via a pipeline. The last concept is a so-called quick cash. The cashier in the quick cash performs the same functions as the central cashier. But also clients with simple withdrawal transactions can be handled.

If a central cash system or a quick cash system is applied, two types of cash-transaction, return and no-return are of interest. The handling of a 'no-return' transaction, for example a deposit, is simple. When the transaction is sent to the cashier, the clerk can proceed with the next transaction or client. A return transaction, for example a withdrawal, implies that a client cannot leave the counter before the clerk gets response from the cashier. During the period that the return transaction is processed by the cashier other transactions of the same client can be handled by the clerk. In case of a clerk's own cash system there is no distinction between return and no-return transaction, for the clerk has to perform all the activities associated with the transaction.

The accommodation at the counter to handle transactions depends on the time it takes to handle the transaction. There exist three types of counter accommodation. In the first place there is the standing accommodation. This accommodation is merely used at counters for transactions with a short processing time, for example deposits and withdrawals. The clerk sits or stands behind the counter and the client stands in front of the counter. Transactions which normally take a longer time are handled in a sitting accommodation, where the employee as well as the client sits. These sitting accommodations are merely used for advice, special and time consuming transactions. There is also a mix of the sitting and standing accommodation, the so called combi-accommodation. This accommodation has a standing accommodation as well as a sitting accommodation.

The staffing of the counters depends on the kind of transactions, which can be handled on the counter. There are three kinds of employees available: the clerk, the first clerk and the consultant. The first clerk can handle all the transactions which can be handled by the clerk and some additional transactions. The consultant can handle all the transactions, assigned to that counter.

Directly related to the bankhall concept is the client's behaviour. The behaviour of the client depends on the type of client and the transactions he has with him. There are two main client types, the private and the business client. In general the business client (the smallest group) is served at a special counter. At this counter, mostly at the far end of the bankhall, private clients cannot be handled. Another aspect of the behaviour of the client is the length of the queue in front of the counter. The client will always choose the counter where he can handle most of his transactions. And if there is an alternative he will choose the one with the smallest queue length. Clients who have only withdrawals are mostly handled by an ATM or a quick cash if available.

The assignment of a clerk to a client is according to the transaction list of the employee and that of the client. In principle a clerk is assigned to handle the client. When there are transactions, which cannot be handled by the clerk, the first clerk comes into action. To handle the most difficult transactions, the consultant serves the client.

3. The model implementation

The users of the simulation model support the consultants of the local banks. They have a very little knowledge of computers and operating systems. Therefore much attention is paid to a user-friendly dialogue system. No special training is needed; on all control levels help is available. The simulation model is implemented on a PC in the process oriented language Simscript. PC-Simscript which is incorporated in the simlab development environment has a lot of facilities available such as mouse-driven pull down-menu's, graphics and animation. These facilities are easy to use when building user friendly dialogue systems.

The nature of the simulation model itself is a queuing system. Therefore the model needs information on the arrival pattern of clients and their transactions and information on processing times of these transactions. For each client type there is an arrival pattern and a transaction distribution. The processing times of the cash transactions depend on the cash organization. For example a withdrawal at the ATM has a shorter processing time than a withdrawal at a money counter with a central cashier. The processing times are split up in logical parts depending on the cash organization. Modification of a component of the organization can easily be adapted.

Before running the *simulation model* the bankhall and the *initial* conditions have to be defined. In the first place there are the counters. For each counter the cash organization, the staffing, equipment, type of clients and the transactions which can be handled by the clerks have to be defined. The counters determine which cash system is used. In the second place there are the ATM's. For each ATM the type of ATM, the type of client and the transactions which can be handled have to be known. The initial conditions are the number of simulation runs, the simulation period and the number of clients in front of the door at the beginning of the simulation run. The data concerning arrival patterns and transaction distributions together with model specifications and initial conditions can be saved as model data.

The results to support the decisions are presented for each client type and counter or ATM. The results are queue lengths, waiting time, idle time, workload and utilization. Also some input data such as bankhall layout, arrival patterns and transaction distribution is presented.

4. Working with the simulation model

The first activity before using the simulation model is data collection. During a period of 2 to 4 weeks arrivals and transactions are registered. The registration is done manually. The cash transactions are recorded by the counter system. However this system has a very poor report facility. Therefore the summary of the recordings has to be copied manually. The data collected are processed by a data collection program, which calculates the arrival patterns and transaction distributions for the simulation model.

After the data collection, the arrival patterns and transaction distributions together with some general information are read by the simulation model. At this point the interactive modelling starts. Counters and ATM's are defined by using the dialogue system. To evaluate the model, the current bankhall is simulated. After this evaluation the transaction distributions and arrival patterns are updated to meet future expectations. The bankhall layout is adjusted. After the update and adjustments the simulation model is run. This process goes on and on until an adequate bankhall concept is found.

5. Problems

In this project there are two main problems. One problem is the user of the system and the other one is the performance of the simulation model. The user of the system has a marginal knowledge of simulation and therefore no feeling in what is essential in the simulation model. To cover his lack of knowledge all possible details are requested to add to the simulation model. This turns out to be a tremendous assault on the performance. It appears that the user has no feeling with simulation. Often the user starts for example with an undersized model so the workloads of the employees are approximately 100%. This resulted in very long execution times.

The other problem was the performance. The model has been built on a PC in PC-Simscript. PC-Simscript operates with virtual memory by using a swap file. Simulation of a large bankhall using graphical displays causes a lot of swapping. As time proceeds the swap file grows which leads to performance reduction. This problem can be solved by running the model on a MicroVax and using the human interface on the PC. This requires additional communication software. Of course, sending the model data to and receiving the results from the alternate computer is also time consuming but in relation to the processing time, on the alternate, it can be quite profitable. Performance tests on a MicroVax 2000 resulted in an eight times shorter processing time.

6. Conclusions

If a process oriented language is used the design of a bankhall simulation model is not a very difficult task. To implement the model with a user friendly interface is time consuming although adequate tools are used.

A minor problem is that of the data collection. This can be solved when in the future the counter systems have report facilities for management information.

The user is one of the critical success factors of the system. If the user lacks knowledge of simulation and decision problems it is very hard to make the simulation model successful. The user has to be educated in using simulation models. Training is not sufficient.

Simulation of very large models on a PC leads to strong performance reductions. To cope with the performance problem it is comfortable to have escape routes, for example to migrate the model to a faster machine.