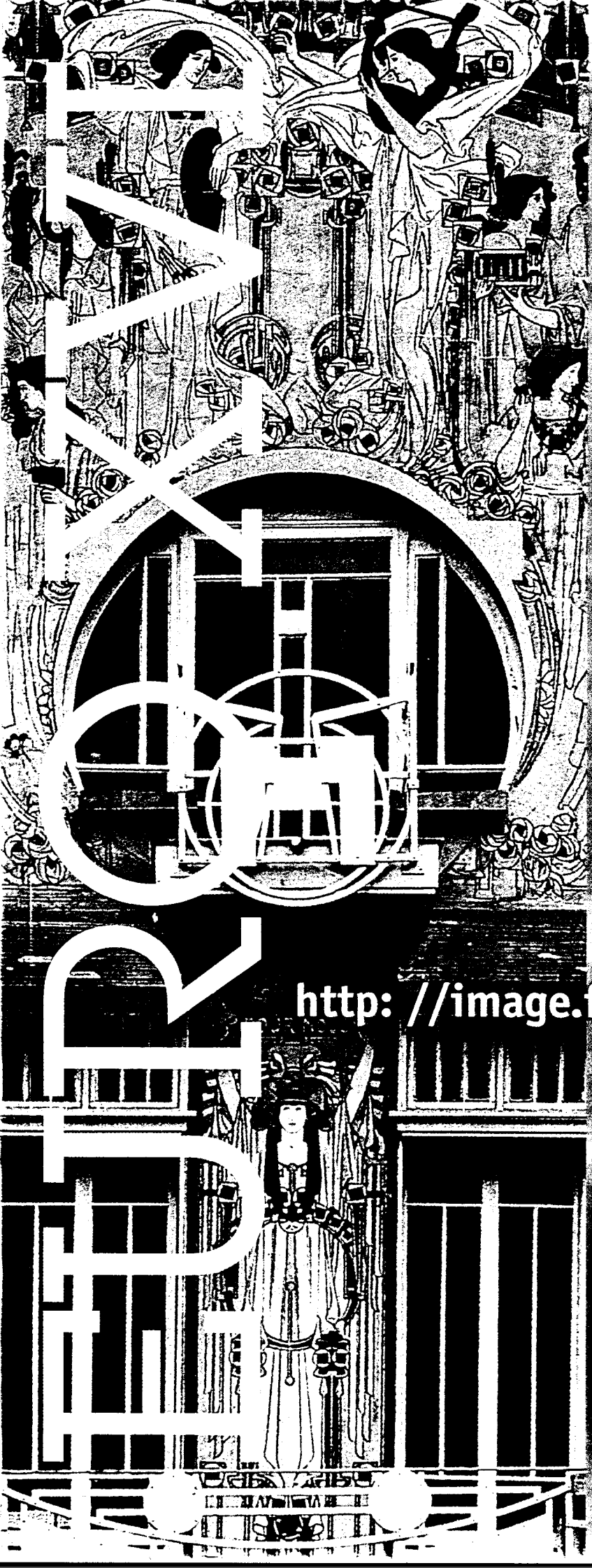

16th European Conference on Operational Research
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Programme

Innovation and Quality of Life

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EURO XVI

Hosted by SOGESCI-BVWB - The Belgian Operations Research Society

1 Is O.R. global ? (Room 1)

Org.: *RAND Graham (United Kingdom)*
Chair: *RAND Graham (United Kingdom)*
Panel:

MULLER-MERBACH Heiner	(Universitat Kaiserslautern)
SNIEDOVICH Moshe	(University of Melbourne)
WEINTRAUB Andres	(University of Chile)

The speakers will introduce a general discussion about the global applicability of O.R. (Is there one O.R. or subsets of O.R. applicable to different regions, different economics, different cultures, . . .)

2 Simulation I (Room 2)

Chair: *VAN DER ZEE Durk-Jouke (The Netherlands)*

2.1 Look-ahead strategies for on-line scheduling of multi-server batch operations, *VAN DER ZEE Durk-Jouke (The Netherlands) – VAN HARTEN A. – SCHUUR P.C.*

Many planners in industry are confronted with little and incomplete knowledge of customer demand when scheduling jobs. Look-ahead strategies are a means to deal with these situations: given the information on customer demand for a short time horizon they decide on when to schedule a job using some criterion for optimisation. Guided by research in aircraft industry, where the process of hardening synthetic aircraft parts was studied, a look-ahead strategy is proposed for the on-line scheduling of multi-server batch operations. Based on the knowledge or forecast of a few near future arrivals the strategy supports the planner in scheduling jobs in order to minimise logistical costs. The fact that different cost structures can be incorporated, makes it a valuable tool for use in practical situations in business. The potential of the new strategy is demonstrated by an extensive series of simulation experiments, in which its response for various system configurations was tested in comparison with other heuristics.

2.2 A simulation environment for the development and assessment of real-time control strategies for FMS, *KEHRIS Evangelos (Greece) – DOULGERI Zoe*

A generic software library written in C is developed to support simulation modeling of flexible manufacturing systems (FMS) for the development and analysis of real time decision making strategies. The library is consisted of generic FMS modules which are used to construct a specific system and a set of data collection tools which can be attached to FMS modules to facilitate flexible and dynamic data collection.
Input control strategies may be provided by the user in a separate module by making use of the dynamically collected data. This approach is consistent with the distinction between the plant and the control according to the control theoretic framework.
The suggested simulation environment has the flexible characteristics of a simulation language while user involvement in system modeling and data collection is kept minimal.

2.3 A Simulation Tool for Scheduling in Computer Integrated Environment using Petri Nets and Object Technology, *ARSOVSKI Zora (Yugoslavia)*

The operation scheduling in a computer integrated environment belongs to the class of problems that are too complex for mathematical formulation and whose optimal solutions are feasible by traditional OR techniques only for small-scale or idealized scheduling problems. Solutions require knowledge-based systems that combine simulation techniques with those of current expert systems. The quality, i.e., efficiency and accuracy of such simulation tools for real time scheduling are primarily determined by its capability to represent, in authentic manner, the external influences and constraints as well as the internal operational constraints of such environment. Extended Petri Net (EPN) approach using an integration of the hierarchical and object oriented modeling methodology is particularly suitable for such a dynamic simulation experiment. This approach enables scheduling in a dynamic mode and application of dynamic priority rules stored in a separate catalog. The paper points out the strength of this approach with the modeling of concrete job shop scheduling problem in flexible manufacturing system ambiance.

2.4 Effects determination of quality system incorporation in real multilevel maintenance system, *KODZOPELJIC J. (Yugoslavia) – STANOJEVIC Petar – KLARIN M. – MISKOVIC V.*

Income of supported business system is directly proportional to a number of working technical items per day. Therefore, minimizing of down time and maximizing of average number of working crucial technical items (machines) per day (ANWTI) (or average percent of working technical items per day) are primary goals for real multilevel maintenance system (RMMS). Complexity, stochastics and unstationary process character in RMMS and large number of influencing factors made modeling and simulation a basic investigation methodology tool. RMMS process investigation was made in function of cost-benefit analyze of investment in organizational and process redesign, equipment and staff training for quality system based on ISO 9000 incorporation. Influence on effectiveness and efficiency of maintenance and business systems was investigated in the case of possible changes of maintenance service quality factors as follows: a) readiness for maintenance action, b) maintenance system functioning reliability and c) confidence (safety) in quality of maintenance action. Investigation results had shown that diagnostic accuracy (parameter of confidence) for minimum step of change maximally influenced ANWTI. In the case of diagnostics accuracy raising up for to 10% RMMS could expect raising of ANWTI up for to 15%. Significant influence (raising of ANWTI up for to 5%) on maintenance system functioning had maintenance concept (strategy) and quality of single maintenance action improvement (parameters of maintenance system functioning reliability). Raising up more than 0.9-0.95 for probability that maintenance system would be ready for action without delay (parameter of readiness) did not show significant effects on efficiency and extremely raised up costs. Cost-benefit analyze lead to conclusion that diagnostic accuracy raising up for to 6% only would approve all investments in organization and process redesign, equipment and staff training for Quality system based on ISO 9000 incorporation.

3 Artificial intelligence and decision I (Room 3)

Org.: *DE BAETS Bernard (Belgium) – FODOR János (Hungary)*
Chair: *DE BAETS Bernard (Belgium)*

3.1 Sugeno integral as an aggregation operator, *MARICHAL Jean-Luc (Belgium)*

Aggregation refers to the process of combining numerical values into a single one, so that the final result of aggregation takes into account all the individual values. In decision making, values to be aggregated are typically preference or satisfaction degrees and thus belong to the unit interval.
This paper aims at investigating the Sugeno integral which can be regarded as an aggregation function. In particular, we show that any Sugeno integral is a weighted max-min function. We also show that such a function can also be written in a dual form as a weighted min-max functions. The correspondance formulas are given as well.
We also propose an axiomatic characterization of this class of functions based on some aggregation properties: the increasingness and the stability for minimum and maximum with the same unit.

Most of these results are applied to the Sugeno integral. In particular, we can derive equivalent expressions and characterize the family of all the Sugeno integrals.
We also consider particular weighted max-min functions: Boolean max-min functions, weighted maximum and minimum functions, ordered weighted maximum and minimum functions, partial maximum and minimum functions, order statistics and associative medians. Of course, all these functions are Sugeno integrals.

3.2 A characterization of the Choquet integral in multicriteria decision making, *GRABISCH Michel (France) – MODAVE François*

The Choquet integral with respect to a fuzzy measure has been widely used in multicriteria decision making. However, a representation theorem, linking preferences of the decision maker to Choquet integral is still missing. In decision under uncertainty, the probabilistic model of Savage (expected utility) has been enlarged by Schmeidler and later Wakker, replacing the probability measure by a fuzzy measure, and an usual expectation by a Choquet integral. Thus, there exist in this field several representations theorem of the Choquet integral. It is possible to make a formal analogy between multicriteria decision making and decision under uncertainty, so that it may be possible to benefit from the results of one paradigm to the other one. However, there exist some difficulties for doing a complete analogy (e.g. commensurability). We propose a solution to this problem, and present a characterization of the Choquet integral in the multicriteria decision making framework.

3.3 Relations between logical operators and aggregation in multicriteria decision. Pliant operator system, *DOMBI Jozsef (Hungary)*

One of the most important task faced by decision makers is a selection, because they require conflicting criteria or attributes. On one hand over the past few decades a number of interesting tools have been presented to support selections (MAUT, ELECTRE, AHP, PROMETHEE, SMART, VIMDA, ARIADNE .. .), on the other hand a number of multiattribute decision making methods are available (Dominance, MAXIMIN, MAXIMAX, Conjunctive method, Disjunctive method, Lexicographic method, Elimination by aspects, Linear Assignment method, Simple additive weighting method...). All tools and methods use only a restrictive class of operators. Usually they are aggregations or logical operations. Why is it so? Because from theoretical point of view heterogeneous operators can not be handled efficiently. In real word problems we have to use for some criteria logical operators and afterwards we make aggregation on the results, or strengths of preferences are aggregated, and logical operators are used afterwards. In the paper we offer a consistent operator system, in which all the above mentioned operators appear. They are consistent. It has a neural network interpretation, and the parameters can be learned. It gives a new perspective for practical application. The developed system is so-called Pliant-logic (flexible) and it is the generalization of fuzzy operators.

4 Agriculture (Room 4)

Chair: *FAULIN Javier (Spain)*

4.1 Integration Processes of Agrarian Producers in a Canning Company. An Application of Linear Programming in Workforce Design., *FAULIN Javier (Spain) – ALFARO José Antonio*

An operative model is presented that describes the demand of food-canning companies. A problematic area in the canning sector has always been the adaptation between raw material supply vs. demand by production departments. This problem is solved through the design of a series of linear programming models.
This paper includes decision processes in agriculture, which are based on linear programming for the purpose of forming an adequate workforce to meet production demands. The aim of this paper is the planning of canning company staff based on the volume of raw material needs. The tools used are linear, goal, and integer programming.

This paper correlates supply and demand with the just in time technique. This type of supply and demand management policy must be carried out with the help of farmers, individually or collectively by means of agrarian co- operatives. This effort to coordinate supply and demand depends on the integration of agrarian producers in the productive structure of the company.

The application of improved operative techniques, which facilitate the adaptation of raw material supply and demand, is necessary. These techniques belong to the field of mathematical programming, as tools of operations research. Linear programming and goal programming is implemented in several questions, such as agrarian producer's choice and harvest planning. The core of the present paper is constituted by the implementation of these types of techniques.

4.2 Methology For Preparation of Water Management Master Plan in Croatia, *PETRAS Josip (Croatia)*

The basic plan for water management is "Water Management Master Plan" (WMMP). In the Republic of Croatia there is no integral WMMP for the country as a whole. However, there is a partial plan for particular regions only. An integral WMMP is now in preparation. The quality of the plan primarily depends on its preparation methodology. Using the experience of developed countries in making such plans, as well as scientific knowledge in the fields of axiology, operational research, theory of water resources system and other modern disciplines relevant for solving problems related to water resources, a procedure for the preparation of WMMP in Croatia has been proposed. It is based on the general strategy for complex problem solving, known in operational research theory as "Problem Solving Technology". The proposed procedure includes two schemes for the solving of water management tasks (optimisation analysis tasks and optimisation synthesis tasks) based on the water resources systems theory. The proposal of the procedure for the making of WMMP in the Republic of Croatia is described in the paper.

4.3 An agricultural sector model of Portugal: an applied mathematical programming model under risk, *SERRAO Amilcar (Portugal)*

This research work develop a mathematical model under risk for assessing impact of New CAP reform called Agenda 2000 on the Portuguese agricultural sector. This model maximises consumer and producer surpluses, determines which agricultural products (if any) of Portugal have comparative advantage in international trade, identifies changes in crop and livestock patterns under Agenda 2000 and projects agricultural production and trade by commodity for the 2000s. Model structure incorporates risk through the sum of positive and negative deviations of farm income from its mean into the objective function. On theoretical grounds, neglect of risk-averse behaviour in agricutural sector models can be expected to overestimate the output levels and the value of important resources. The validation process consists of comparison of quantities produced and market prices for agricultural commodities from simulations experiments with the corresponding observed values for these variables in 1994. On production side, all commodities show differences 10% below observed levels. The simulation results with respect to market price are much less satisfying, with a number of prices at least 60% below obseved prices. Model results do not support the proposals and policies suggested in Agenda 2000. Portuguese farm income will be significantly reduced for the traditional crop and livestock farms. Agenda does not support the southern products that might be an alternative to traditional crops and livestock products and help to stabilise farm income in the Mediterranean countries such as Portugal, Spain, Italy and Greece.

30 Public sector (Room 30)

Chair: *PARKAN Celik (Hong Kong)*

30.1 Performance measurement in the public sector, *PARKAN Celik (Hong Kong)*

The Department of Electrical and Mechanical Services (DEMS) of Hong Kong Government maintains the electrical and mechanical equipment in all the buildings and facilities owned by the government, including the Hong Kong International Airport. We present the results of a performance analysis of the operations of DEMS using the method of Operational Competitiveness Rating Analysis (OCRA).

30.2 OR in Crime Prevention, *ITTMANN Hans W (South Africa)*

Crime is possibly one of the most serious problems and threats to the new democracy in South Africa. It is hampering economic growth in various ways ie creating more internal instability in the country, it is not conducive to attacting international investment to the country, tourism is seriously affected, etc. The government has identified crime prevention as one of the national priorities and there is a wide and concerted effort to address this serious situation. This paper will describe a number of initiatives currently underway using operations research to assist in the combating of crime.
Crime statistics at strategic and operational level is very important for planning and decision making. We will show how GIS and various modelling techniques were used for this purpose. Operational decision support tools are also very useful for the police officer in an operational capacity. Various such tools have been identified to assist in this way, we will discuss these and there implementation. Court Management is another area where we have provided input and assistance, this will also be described. With the involvement of the OR consultants over the last year some significant breakthroughs have beenmade and these will be outlined in the paper.

30.3 OR as an aid to public sector decision-making, *FOURIE Philip (South Africa)*

The social and economic goals for South African society as envisaged by the present government are embodies in two programmes, namely the Reconstruction and Development Programme (RDP) and the Growth, Employment and Redistribution programme (GEAR). In practice the attainment of these goals is hampered by the lack of resources, especially money and trained people. In this situation it is very important that the available resources be used as effectively as possible. The South African OR Society is actively propagating the application of OR methods to improve decision-making in the public sector. A description of this effort will be given, as well as some specific applications.

30.4 Optimization models of the national postal distribution network, *JABLONSKY Josef (Czech)*

The paper presents two models for optimization of the postal distribution network in Czech Republic. The first of them is the model for selection of the subset of transhipment points from the set of 69 transit centres, determination their facilities by sorting machines and the assignment of transit centres to the transhipment points. The objective of the optimization is the minimization of the investment and operational costs. The proposed model is the standard linear optimization model with integer variables (several thousands of variables and constraints). The second model deals with cost optimization of pick-up and delivery routes within the city distribution network containing more than 100 nodes. It is the complex vehicle routing problem with time windows, capacity restrictions and many other conditions. The problem is solved by means of original heuristic procedure. The final output of the model is the daily time-table for all of the travel routes.

31 Game theory I (Room 31)

Chair: *ROUBENS Marc (Belgium)*

31.1 Power Indices Based on Ordinal Games, *ROUBENS Marc (Belgium) – MARICHAL Jean-Luc*

Shapley (1953) and Banzhaf (1965) solved multiperson cooperative games by assessing a value (power index) to each player of a game. Shapley value can be interpreted as giving each player his average marginal contribution to all coalitions of players. Banzhaf power index related to a player corresponds to the probability that a coalition wins when the player joins randomaly the coalition.
In some practical situations, the real valued set function and the set of players N that defines the game can be determined only up to the order. An ordinal game is a linear preorder defined on the power set of N. The problem is to rank the players (i.e. to give a linear preorder on N) with the use of the ordinal information.
We propose to use the uniform ranking value to solve the problem. As done for the Shapley and Banzhaf power indices, we propose some natural properties fulfilled by this ranking method, which could lead to an axiomatical characterization.

31.2 Alice, Bellman and Charles Dodgson: a case of 19th Century Dynamic Programming, *SMITH David K (United Kingdom)*

Besides writing the two world-famous children's books about Alice, Lewis Carroll (Charles Dodgson) was a collector and inventor of puzzles. Some are logical, some are concerned with words, and many are mathematical. Newly published papers and letters reveal details of a two-person sequential mathematical game. In this conference paper we shall consider ways of using dynamic programming to solve this game. Defining the "state" is not straightforward, leading to the need for careful structuring of the computational process. We shall also consider how Lewis Carroll played the game, two generations before Richard Bellman's development of dynamic programming.

31.3 N persorn sequential selection of optimal contracts, *SZAJOWSKI Krzysztof (Poland)*

Let (X(n),F(n),P) be a homogeneous Markov process defined on a fixed probability space with state space E. There are r decision makers. At each moment n=1,2,...,N the decision makers (henceforth called players) are able to observe the Markov process sequentially. Each player has his utility function g(i), i=1,2,...,r and at each moment n each decides separately if he accepts or rejects the realization x(n) of X(n). If it happens that both players have selected the same moment n to accept x(n), then a lottery decides which player gets the right (priority) of the acceptance. Priority of i-th player is proportional to a(i). The aim of the players is to choose the realization which maximizes his utility function. The non-zero-sum game approach is used. A formalization of the model is given and a construction of Nash equilibria for a finite horizon game is given. The model is generalization of the two person games considered in Szajowski (1994) and N person game solved in Enns et al. (1987).

31.4 On The Existence of Solutions to Coupled Riccati Equations and The Geoffrion Equilibrium in Differential Game Under Uncertainty , *RADJEF Mohammed Said (Algeria) – CHERIEF Lynda*

For the two-person linear quadratic differential game under uncertainty, the existence of objection and counter-objection Geoffrion equilibrium depends on the existence of continuous solutions to an associated system of two strongly coupled Riccati differential equations over a finite period of time. In this paper, we present the sufficient conditions for existence of solutions to the associated system by using a simple result from the theory of differential inequalities. They are given in terms of upper bounds on the length of the time interval interest.