

NEWSLETTER

Executive Committee: HW Ittmann, P du T Fourie, FE van Dyk, T Stylianides, SG Berjak, LP Fatti, WR Gevers, KJ Koch, JH van Vuuren, SE Visagie, DW Evans, M Turpin, TJ Stewart, A-M Pothas, D Petkov

NATIONAL CONFERENCE 2002 NASIONALE KONFERENSIE 2002

Goudini Spa, 8-11 September

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FROM THE PRESIDENT'S DESK

By Hans Ittmann
ORSSA President
hittmann@csir.co.za



Hans Ittmann

Operations research is a hugely exciting, stimulating and fascinating field! OR has had a profound impact on a wide range of issues over the last 50 to 60 years in the public, private and military sectors of society. Why state this now and why this sudden excitement? Some background may be appropriate. Operations Research as a discipline originated during the last world war. After the war it took some time before OR professionals got together to organise themselves in professional societies, etc. It was only during the early fifties that things got off the ground and it happened almost simultaneously on both sides of the Atlantic Ocean. During that time a number of OR journals were also launched. The flagship journal, *Operations Research*, of the American Operations Research fraternity has just published the 50th year anniversary issue, Volume 50, Number 1,

Jan/Febr 2002 and that is where the excitement comes from!

The anniversary issue contains 33 articles from a variety of authors covering a wide range of different topics. Many of the articles are personalized reminiscences of the various authors around specific themes; others are a personalized review of an entire research area, etc. The authors are almost the "who's who" of OR in the States although a few articles are from authors outside of the USA. In some cases, one may feel that the authors are typical Americans indulging themselves; this is part of the reminiscence! What I found so exciting and fascinating are the areas where OR has played a role and has made an impact. It is clearly not comprehensive but it covers, to name but a few, crime modelling, energy modelling, traffic, public sector OR, OR in Health Services, Army Operations Research, Navy Operations Research, etc. as well as specific techniques such as linear programming, simulation, applied probability, decision analysis, inventory control, networks and queues, the birth of dynamic programming, early integer programming, etc. American OR is much more mathematically orientated so many of the articles describe what techniques were developed, but from most of the articles, it is clear that there are also many, many different applications, which made real impact in the respective

June 2002

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environments. What other discipline or field can claim this rich and comprehensive contribution to almost every sphere of life?

Crime modelling, for example, introduced the notion of simulation to the criminal justice systems. A paper published in 1969 was the first formal introduction of modelling of crime and the criminal justice system to the OR community. The oil crisis, in the early seventies, stimulated energy modelling work for policy studies. Even today, this is continuing and the process is focussed on solving real problems. Some work in my own environment is currently happening in these two areas and it is gratifying that we are also involved in this kind of work in South Africa. It is fascinating to read Leonard Kleinrock's story on creating a mathematical theory of computer networks. He "set up the mathematical model using queuing theory, introduced the critical Independence Assumption, evaluated network performance, and developed optimal design procedures for determining the capacity assignment, the topology, the routing procedure, and the message size". For this work, he is considered the inventor of the Internet technology and, therefore, one of the fathers of the Internet. There is an article on computational tools for linear programming. The article reflects very recent work that is primarily focussed on one issue, solving larger, more difficult linear programs faster. Advances in computer technology has surely assisted in solving LP's faster but algorithmic and software improvements have been equally important. They have test problems with more than 6 million constraints! Optimisation engines are now available that dwarf what was available only a few years ago, making possible the solution of real-world models once considered intractable! Harvey M Wagner (yes the author of that famous handbook, *Principles of Operations Research* – anyone who studied through UNISA during the seventies should still remember this book!) relates his experiences with inventory control models. He tries to indicate why we still find empty shelves in the shops where we do business despite a half century of impressive research in inventory modelling, augmented by supply chain management software. The two central questions in automated inventory control is: (i) Is it now time to replenish inventory?; and (ii) What should be the order quantity? These questions are rooted in the requirements of practice and not in the underpinnings of inventory theory. All of this is wonderful stuff - does anything more need to be said!

This anniversary copy of *Operations Research* is available and single copies of this issue can be obtained by contacting informs@informs.org. In addition you can visit the INFORMS website at www.informs.org and select publications to see who contributed to this issue.

This copy of the newsletter has information on the national conference and I would like to urge members to attend this annual highlight of the society's activities. It is usually a very pleasant occasion and the venue of this year's conference already suggests a wonderful event! We are also inviting submissions for the Tom Rozwadowski medal for 2002. This is the most prestigious award the society can make to one of its members and we would like to ensure we consider all possible reports, papers and things our members have published for this award. Make sure you attend to this as well!

Die drie jaarlikse IFORS kongres vind vanjaar plaas in Edinburgh, Skotland. Die datums is van 8 tot 12 Julie 2002, wat sommer om die draai is. As ek so vinnig na die program kyk, en dit is 'n baie lywige program, blyk dit of ons die beste opkoms nog van Suid-Afrika gaan hê. Ek het maklik tien, vyftien aanbiedings deur Suid-Afrikaners gesien en 'n klompie is ook van persone wat nie lede van ONSA is nie. That brings me to an issue that we keep on raising and that revolves around membership, specifically payment of the membership fees. Can those members that have not paid their fees please do so as soon as possible, it will really be appreciated tremendously!

Ons poog steeds om ons takke meer aktief te maak. Skakel gerus met een van die volgende tak-voorsitters: Dave Evans (Johannesburg), Marita Turpin (Pretoria), Jan van Vuuren (Stellenbosch) en Kathryn Koch (Pietermaritzburg). Hulle sal u met ope arms ontvang sodat u by die verskillende takke se bedrywighede kan inskakel.

EDITORS NOTE

This edition of the newsletter contains many interesting articles, including a profile of Theo Stewart and a biography of Tom Rozwadowski - taken from the June 1971 newsletter. The ORSSA executive committee would like to call on all its members to submit nominations for this year's TR medal (see page 4 for further details).

Once again there are plenty of reminders about the upcoming annual conference, which promises to be a really excellent affair. Plenty of hard work has already gone into organising this event - so it is now up to all of you to show your support by attending the conference.

Stephen

Address all queries or contributions to the editor:

Mr S.G. Berjak
Department of Applied Mathematics
University of Stellenbosch
Private Bag X1, MATIELAND 7602.
E-mail sberjak@dip.sun.ac.za
Tel: (021) 808 4450
Fax: (021) 808 3778

DISCLAIMER

The views expressed in this newsletter are those of the contributors, and not necessarily those of the Operations Research Society of South Africa. The Society is not responsible for the accuracy of details concerning conferences, advertisements, etc., appearing in this newsletter. Members should verify those aspects themselves if they intend to respond to them.

TOM ROZWADOWSKI

(TAKEN FROM THE JUNE 1971 ORSSA NEWSLETTER)

Tom Rozwadowski was born in Poland on 10 January 1938. His ancestors, both on the paternal and maternal side, belonged to well known families of the Polish nobility, who served with distinction in various capacities in past centuries. Tom spent the war years in occupied Poland with his mother and elder brother, whilst his father fought with the Polish forces in Europe. Tom's mother, having moved to Warsaw in 1943 with her two sons, endured with them the insurrection against the Germans that ended in the destruction of 80% of the town and the mass deportation of its inhabitants.

The family was reunited in 1945 in West Germany. They moved to England in 1947 and eventually settled in South Africa in 1948. Tom was educated in various colleges in the Cape Province, where he matriculated at the Marist Brothers' St Joseph College in Rondebosch.

In 1956, following his vocation to become a Marist Brother, he was sent to their Noviciate in New South Wales, Australia. He left the religious life in 1959 and returned to South Africa in 1960.

He obtained his B Sc at the University of Cape Town in 1961 and then joined Leo Computer Bureaux in Johannesburg, where he worked until 1965. He obtained his B Sc Honours (Mathematics) at the University of South Africa in 1965, and in the same year he joined Control Data (Pty) Limited in Johannesburg. After completing his M Sc thesis at Wits University, he left for the USA to conduct research in the computer field at CDC Headquarters in Minneapolis. Before his untimely death, he was already preparing his Ph D degree.

Tom was an "all rounder", his interest ranging from philosophy to computers to operations research. He spoke five languages fluently. At school, he excelled in sport, winning several athletics cups, and he was a keen rugby player. He enjoyed tennis up to the end of his life.

In the operations research field, he was a specialist in optimisation techniques, whilst also having a good knowledge of inventory control, game theory, simulation and dynamic programming. Some of the work he did at Leo included the design and supervision of a full-scale PERT suite; the writing of a series of programs embodying several linear programs to optimise order batching and paper cutting for a large paper mill; a system for controlling the production of glass work; and a study on the use of computers for real time control of traffic. As a computer man he was quite capable of writing the best part of twelve volumes of a tender all by himself in a month!

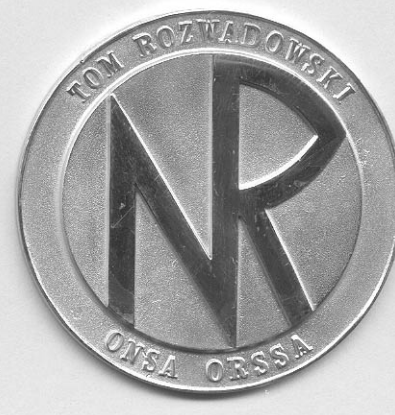
He was the driving force behind the establishment of an operations research group in Johannesburg and a member of the group which founded the operations research society of South Africa.

He would tackle anything that came his way and would not give it up until some results had been achieved. His interest on how to measure the performance of computers prompted him to produce

a paper (1966) in which he examined the question from a macroscopic point of view. Thus he gave criteria to assess the performance of CPU, of I/O processors, of the software and the computer throughput. However, in 1970 he reopened the question, asking himself what a computer actually does; what instruments would one use to measure the work done by a computer; what mathematical model would one use to assess the performance from the microscopic point of view? Tom used the concepts of information theory, such as uncertainty and entropy, and gave the clues to the performance indicator for a computer.

The same pattern of development took place with his interest in gold mining. In 1963, he developed a computer program for JCI that performed all the required calculations to evaluate the present value of any fully specified mining policy. In addition, in 1966, he helped to develop a computer-based management game of a gold mine to try out the various possible types of decisions encountered in mining operations.

RECIPIENTS OF THE TOM ROZWADOWSKI MEDAL



1971 - **G J Rudolph** "Optimal Mail Sorting Policy"

1976 - **B J K Smith** "A Medium Term Planning System for a Beach Diamond Deposit"

1977 - **P J Vermeulen and D C J de Jongh** "Parameter Sensitivity of the 'Limits to Growth' world model"

1978 - **T J Stewart and H W Ittmann** "Two-Stage Optimization in a Transportation Problem"

1979 - **J S Wolvaardt** "n Teorie van die aanbod van steenkool"

1980 - **T J Stewart** "Contributions to Search Theory"

1981 - **L P Fatti** "Optimal Smoothing of Demand for Industrial Gas"

- 1982 - **P J S Bruwer** "Bydraes tot Model Ontwikkeling ten einde gerekenariseerde stelsels se werkverrigting te evalueer"
- 1983 - **J C Lawson** " A Purchasing Problem"
- 1984 - **T J Stewart** " Contributions to MCDM"
- 1985 - **D C Currin and H W Ittmann** "Multi-Product Allocation and Distribution"
- 1986- **M Sinclair** "The Assignment of Workers to Tasks – An Example from an Academic Department"
- 1987 - **K C Jordi** "Interactive Multiple Objective Linear Programming"
- 1988 - **M Sniedovich** "C-Programming"
- 1989 - **G J Wessels** "A Geometric Programming Algorithm for solving a class of non-linear, signomial optimization problems"
- 1990 - **E C Dixon** "Modelling Under Uncertainty: comparing three acid rain models"
- 1991 - **M Sinclair and H C de Kock** " Three-level decomposition approach for solving feedstock problems on micro computers"
- 1992 - **J Swart and J Hearne** "Optimal Translocation Strategies for saving the Black Rhino"
- 1993 - **G Erens, P Salemink and C A van der Merwe** "Regional Manpower Planning"
- 1994 - **R de Jongh, K Carden and N Rogers** "FUTURE: A Knowledge-Based System for Threat Analysis"
- 1995 - **T J Stewart** "Contribution to MCDM over the past ten years"
- 1996 - **T J Stewart and L Scott** "A Scenario-based Framework for Multicriteria decision analysis in water resource planning"
- 1997 - **I Gryffenberg, J L Lausberg, W J Smith, S Uys, S Botha, F R Hofmeyr, R P Nicolay, W L van der Merwe and G J Wessels** " Guns or Butter: Decision Support for Determining the Size and Shape of the South African Defence Force"
- 1998 - **T Stylianides** "A Model of Clinker Capacity Expansion"
- 1999 - **R C van der Honert** "Stochastic group preference modelling in the multiplicative AHP: A model of group consensus"
- 2000 - **J Hearne and M Mckenzie** "Compelling Reasons for Game Ranching in Maputaland"
- 2001 - **J H Van Vuuren and G E Huddlestone** "Seeking Optimality in Fruit Pulping Schedules: A Case Study"

In 1970 he had produced a massive thesis in which, using advanced operations research techniques, such as the decomposition method in linear programming and the Lagrangian multiplier in the case of dynamic programming, he had developed a mathematical model to provide truly optimum solutions to the long term mining problem, taking into account such variables as taxation and uncertainty. His results were such that where no capital expenditure was involved, the present value was maximised and, where capital expenditure was involved, the present value was a maximum subject to an adequate return on capital.

He did not consider the question closed, and was suggesting the use of simulation techniques to try out short-term tactics in mining operations, coupled with further and more sophisticated usage of linear and dynamic programming for the long-term planning.

On Monday, 12 October 1970, the news was circulated at Control Data South Africa that a telex had arrived during the weekend from the USA giving the announcement of Tom's death. Later the details became available. Tom and his family had gone to spend the weekend a few miles outside Minneapolis, apparently to give a talk on South Africa in a Catholic Church at Annadale, Minnesota. They had been put up for the night in a cottage as guests of the church. The gas central heating had a leaking pipe and the next morning Tom, his wife and their two children were all found asphyxiated.

All those who knew Tom will remember him for never refusing a helping hand to anybody in need of it. When Tom turned his head to listen to the problems put to him, there was always a twinkle in his eyes; there was the serene smile of a man who was at peace with himself, and with the rest of the world.

TOM ROZWADOWSKI MEDAL 2002

Nominations/ Nominasies

The Operations Research Society of South Africa would like to invite its members to submit any articles which appeared during the period July 2001-June 2002 to the convenor of the selection committee, Philip Fourie (pdfit@sun.ac.za), for consideration for the medal.

Die Operasionele Navorsingsvereniging van Suid Afrika nooi lede om enige publikasies wat verskyn het gedurende die periode Julie 2001-Junie 2002, vir oorweging voor te lê aan die saamroeper van die keurkomitee, Philip Fourie (pdfit@sun.ac.za).

MEMBER PROFILE: THEO STEWART

By Stephen Berjak
University of Stellenbosch
sberjak@dip.sun.ac.za



Theo Stewart

Theo Stewart was appointed Professor in the Department of Statistical Sciences at the University of Cape Town in 1984, and was Head of Department from 1994-1999. Previously, he had from 1971 worked at the National Research Institute for Mathematical Sciences of the CSIR, where his final position was Director and Head of Operations Research and Statistics. His earlier experience had been as a chemical engineer (1964-1967

Corner House Group, 1967-1971 Sentrachem Group) having completed a BSc(ChemEng) from UCT in 1963.

He studied operations research and statistics part-time through UNISA, completing a BSc(Hons) in 1972, an MSc(OR) the following year, and a PhD in Mathematical Statistics ("Bayes optimal experimental design for determination of a response surface maximum") in 1976.

Theo Stewart was founder-editor of ORiON, the journal of the Operations Research Society of South Africa (ORSSA). He has been president of both ORSSA and the South African Statistical Association (of which he is also a Fellow), and has been awarded ORSSA's Tom Rozwadowski Medal on five occasions. He is currently president-elect of the International Society on Multiple Criteria Decision Making, and chair of the European Special Interest Group on Multicriteria Analysis (one of the working groups of the Association of European Operational Research Societies). He serves on the editorial advisory board of the four international journals: Journal of the Operational Research Society, Journal of Multi-Criteria Decision Analysis, International Transactions in Operations Research (including appointment as guest editor for approximately 6 issues in 2000/2001) and OMEGA - The International Journal of Management Science.

1. You have been involved with ORSSA for many years now. When exactly did this involvement begin and why?

While working as a chemical/production engineer in industry, I became one of the first students to register for the OR programme at UNISA. At the time this was an integrated MSc programme, but was later (during my registration) split into separate honours and masters programmes. As a UNISA student, I was informed of the 1970 ORSSA national conference at ISCOR (held on a Friday and Saturday!), and went along. I immediately joined the society. Two years later, I was "invited" to become newsletter editor, a post which I held for 3 years. I was elected vice-president of ORSSA at the 1976 annual meeting of which I had

been organizer. (With over 150 delegates, I believe this to be the largest ORSSA national conference ever held, excluding some international meetings). After my presidential term, I was asked to investigate the setting up of our own journal, and subsequently became the first editor of ORiON. Somewhere along the line I have also served as chair of the Pretoria and Western Cape chapters, and as national contributing editor to International Abstracts in Operational Research.

2. You are formally trained as a statistician, but now find yourself involved with Multiple Criteria Decision Analysis (MCDA). Discuss some of the highlights of your research career and the usefulness of MCDA as a problem structuring technique?

No, I did not "formally train" as a statistician! I started as an engineer and became interested in OR for plant optimization and trouble-shooting studies, and this led to my registration at UNISA as described earlier. The requirement then was that as part of the original MSc programme, the student should develop mathematics and statistics to degree level, which I did (for "non-degree" purposes). I find it a pity that so few OR graduates today have this dual foundation in maths and stats, which really is a necessary foundation for any good modelling work, even in "soft" OR.

During my MSc work, I became interested in decision, game and utility theory. As there was nobody in South Africa really able to supervise a thesis in this area, I compromised by registering for a PhD in statistics, on applications of decision theory and stochastic dynamic programming to experimental design for response surface modelling. But I remained primarily interested in the OR-type of application, stimulated by work on problems of land use planning and of distribution of agricultural produce. Both were naturally "multi-criteria", even though the terms MCDA or MCDM were not in wide use at that time. Involvement in these and other problems led to my increasing interest in the MCDA area. For the past 10 years, much of this work has been motivated by water resources and energy planning, and project management.

I have an unashamedly chauvinistic attitude when it comes to MCDA. All non-trivial management decision problems are multicriteria. All OR/MS work should start by use of MCDA linked to other problem structuring methods such as soft systems methodology. The rich range of methodologies in MCDA provides the integrating framework within which the tools of OR/MS (such as simulation, mathematical programming, queueing, etc.) can meaningfully be applied. It is an annoyance to me that standard texts on OR/MS say so little about the multicriteria problematique and approach, before lunging straight into the mathematical tools. Where some mention is made of MCDM at all, it tends to be restricted to AHP for discrete choice problems (an extremely limited and misleading view) and to goal programming viewed as an extension of mathematical programming (also a very limited view). In any case, the treatment typically focuses on technical details (eigenvector estimation methods in AHP and varieties of the simplex method for goal programming) which are largely irrelevant to most practice.

3. You have recently co-authored a book titled "Multiple Criteria Decision Analysis: An integrated approach". What are the main themes in the book and why should OR practitioners consider purchasing a copy?

A description of the book (co-authored with Val Belton of the University of Strathclyde, Glasgow) can be found on the Kluwer web site: <http://www.wkap.nl/prod/b/0-7923-7505-X>. In essence we review formulation of problems in MCDM terms, describe varieties of preference modelling and the different methodologies of MCDA, and finally explore links between MCDA and the remainder of OR/MS. I do not know of any other book at this time which gives as comprehensive a coverage of MCDA, as well as the broader OR/MS links. My response to the previous question makes my view clear that understanding of the material covered in this book is critical and essential to research and practice in OR.

4. How do you perceive OR developing in this country in the next few years? How does this compare to developed countries overseas?

We are not an island; we are part of the international community. In this sense there is no distinction between OR in South Africa and OR elsewhere in the world. It is of some concern to me, however, that there are so few in South Africa who really specialize in OR, or become involved in OR research issues, as this must damage our international competitiveness. It is also a concern to me that so many younger graduates seem to chase only the area of finance; there are much more pressing problems in this country, both in the developed sector (such as in manufacturing and logistics, if we are to be internationally competitive) and in the developing sector (job creation, poverty, health).

I need at this point to make a plug for the OR-in-development movement. IFORS has been sponsoring various activities in this area. In my view, a serious problem in developing this theme has been that much of what has been called "OR in development" has been little more than traditional OR (very often mono-criterion!) simply applied in developing countries. There has been inadequate recognition of major qualitative differences between the developing and developed world, such as (for example) substantially different levels of reliability in production and distribution systems (partly as a result of political issues), and the needs to balance job-creation and poverty alleviation in the short term against economic efficiency (a multicriterion problem again, of course!). Perhaps (as the doctrinaire free market enthusiasts will assert without much empirical evidence) economic efficiency will eventually create enough jobs, but the overwhelming evidence is that this will take generations, and we don't have that sort of time! These qualitative differences create a number of challenges for OR. South Africa (possibly together with China and India) is in the position of having a well-developed OR community and first-hand experience of living in a developing world. ORSSA must give the lead in OR for development. I would urge particularly our younger members to get involved.

5. You have been actively promoting students at UCT to join ORSSA and to consider pursuing a career in OR. What is the message you would like to send to young aspiring OR practitioners?

It is really Trevor Wegner has been "actively promoting students

at UCT to join ORSSA".

My main message is contained in my response to the previous question. The OR world provides exhilarating opportunities to be involved where critical decisions are being made, and to make a difference. Not all people are equally well-suited to all applications. Some will find greater fulfilment in the more developed world applications (but, please, not just finance!), while others will relate well to the social and human involvement of OR in development. Either way round, OR is where your skills in computing, mathematics and rational, systematic thinking can make a difference.

The following are an extract of recent publications, taken from a list of approximately 50 refereed papers:

Stewart TJ 1991. *A multicriteria decision support system for R&D project selection*. Journal of the Operational Research Society 42: 17-26.

van den Honert RC & Stewart TJ 1992. *A game theoretic model for mergers and acquisitions*. European Journal of Operational Research 59: 275-287

Stewart TJ 1992. *A critical survey of the status of multiple criteria decision making theory and practice*. OMEGA - The International Journal of Management Science 20: 569-586.

Stewart TJ 1993. *Use of piecewise linear value functions in interactive multicriteria decision support: a Monte Carlo study*. Management Science 39: 1369-1381.

Melville-Smith R Goosen PC & Stewart TJ 1995. *The spiny lobster *Jasus lalandii* off the South African coast: inter-annual variations in male growth and female fecundity*. Crustaceana 68: 174-183

Stewart TJ 1995. *Simplified approaches for multi-criteria decision making under uncertainty*. Journal of Multi-Criteria Decision Analysis 4: 246-258

Stewart TJS & Scott L 1995. *A scenario-based framework for multicriteria decision analysis in water resources planning*. Water Resources Research 31: 2835-2843

Stewart TJ 1996. *Relationships between data envelopment analysis and multicriteria decision analysis*. Journal of the Operational Research Society 47: 654-665

Stewart TJ 1996. *Robustness of additive value function methods in MCDM*. Journal of Multi-Criteria Decision Analysis 5: 301-309

Stewart TJ 1997. *Convergence and validation of interactive methods in MCDM: simulation studies*. in Essays in Decision Making, M H Karwan, J Spronk and J Wallenius (editors), Springer, Berlin, 7-18

Stewart TJ & Joubert A 1998. *Conflicts between conservation goals and land use for exotic forest plantations in South Africa*. in Multicriteria Analysis for Land-Use Management, E Beinat and P Nijkamp (editors), Kluwer Academic Publishers, 17-31

Stewart TJ 1999. *Evaluation and refinement of aspiration-based methods in MCDM*. European Journal of Operational Research 113: 643-652

Belton V and Stewart TJ 1999. *DEA and MCDA: Competing or Complementary Approaches?* in Advances in Decision Analysis, N Meskens and M Roubens (editors), Kluwer Academic Publishers, 87-104

NATIONAL CONFERENCE 2002/ NASIONALE KONFERENSIE 2002

GOUDINI SPA

8-11 SEPTEMBER 2002



The annual conference of the Operations Research Society of South Africa will take place from 8 to 11 September 2002 at Goudini Spa in Rawsonville on the scenic Worcester wine route (about an hour's drive by car through the beautiful Du Toit's Kloof from Cape Town International Airport). Recreation facilities include four heated swimming pools (27-37 degrees Celsius, inside and outside), jacuzzis, springs, tennis courts, a water slide, a putt-putt course, trampolines, electronic games, pool tables, hiking trails and a volley ball court. The conference organizers have decided not to place the conference under the banner of a specific theme since participation over the full spectrum of Operations Research (OR) is welcomed at the annual conference. We hope to see many papers, whether they are of a more fundamental or theoretical nature; about an application of OR in business or industry; about topical issues in OR; or about education issues relating to OR.

Special guest Speaker

The guest speaker at this year's conference is Dr Warren Walker (RAND Europe, and Department of Systems Engineering, Policy Analysis & Management, Delft University of Technology). Dr Walker is an expert in the use of mathematical models in policy analysis and he will be opening and closing the conference with plenary lectures on respectively theoretical approaches towards and applications of policy analysis.

Important Dates

- 1 July 2002: Deadline for submission of abstracts
- 26 July 2002: Notification of acceptance of papers
- 2 August 2002: Deadline for early-bird registration
- 6 September 2002: Deadline for conference registration

Conference registration

Those interested in attending the conference are invited to register online by visiting the conference website at

<http://dip.sun.ac.za/conferences/onsa2002/>

and clicking on *Early-bird Registration*, or by printing a paper copy of the registration form.

Conference fees

- R1625 per delegate for standard accommodation
- R1825 per delegate for private accommodation
- R1375 per student (sharing a room)
- A discount of R100 is available for paid up members of ORSSA and/or early-bird registration (before 2 August 2002).

Die jaarlikse konferensie van die Operasionele Navorsings vereniging van Suid-Afrika sal plaasvind vanaf 8 tot 11 September 2002 te Goudini Spa in Rawsonville langs die pragtige Worcester wynroete (omtrek 'n uur se rit per motor vanaf Kaapstad Internasionale Lughawe, deur die pragtige Du Toit's Kloof). Ontspanningsfasiliteite by Goudini sluit in vier verhitte swembaddens (27-37 grade Celsius, binne en buite), jacuzzis, warmwaterbronne, tennishane, 'n water-glybaan, 'n putt-putt baan, trampoliens, elektroniese speletjies, snoekertafels, bergstaproeies en 'n volley ball baan. Die konferensie-organiseerders het besluit om die konferensie nie onder die banier van 'n spesifieke tema te plaas nie, aangesien deelname oor die volle spektrum van Operasionele Navorsing (ON) by die jaarlikse konferensie verwelkom word. Ons hoop om baie referate te ontvang, hetsy van 'n fundamentele of teoretiese aard; oor 'n toepassing van ON in die nywerheid of sakewêreld; 'n aktuele onderwerp in ON; of opvoedkundige aangeleenthede rakende ON.

Spesiale Gasspreker

Die gasspreker by vanjaar se konferensie is Dr Warren Walker (RAND Europe, sowel as Department of Systems Engineering, Policy Analysis & Management, Delft University of Technology). Dr Walker is 'n kenner in die gebruik van wiskundige modelle in beleidsanalise en sal die konferensie open en afsluit met interessante lesings oor onderskeidelik teoretiese benaderings t.o.v. beleidsanalise en toepassings van beleidsanalise waarin hierdie benaderings gebruik word.

Belangrike datums

- 1 Julie 2002: Sperdatum vir voorlegging van opsommings
- 26 Julie 2002: Kennisgewing van aanvaarding van hydraes
- 2 Augustus 2002: Sperdatum vir vroeë registrasie
- 6 September 2002: Sperdatum vir konferensie registrasie

Konferensiegelde

- R1625 per afgevaardigde vir standaard akkommodasie
- R1825 per afgevaardigde vir privaat akkommodasie
- R1375 per student (wat 'n kamer deel)
- Afslag van R100 is beskikbaar vir opbetaalde ONSA-lede en / of vroeë registrasie (voor 2 Augustus 2002)

Konferensie registrasie

Persone wat belangstel om die konferensie by te woon, word uitgenooi om elektronies te registreer deur die konferensie webtuiste te besoek by

<http://dip.sun.ac.za/conferences/onsa2002/>

en op Vroeë Registrasie te klik, of die papierkopie van die registrasievorm uit te druk.

CHAPTER NEWS

Johannesburg Chapter

Valentines Dinner

The Joburg Chapter recently organized an annual social function for the "Gauteng" chapters. As we'd missed Christmas and New Year, Valentine's Day was used as the excuse, although apart from practically all the attendees being couples, if we are honest, the only connection it had was the timing - it was held on Friday 15th February - close!

It was in the form of a dinner at Hugo's Place, a restaurant near Kyalami, attended by some 30 people. We had a guest speaker, John Anderson, that both John Dean and Paul Fatti of the Joburg Chapter committee knew; Paul had been at University with him, at some undefined time in the past which we didn't pursue too hard!

John spoke very interestingly about the "Sixth Extinction." There are now five fairly well defined major extinctions of life on the planet, as identified by paleontologists, one of which was the famous "dinosaur" one 65 million years ago. Most, if not all, are thought to have been triggered by massive asteroids hitting the planet. A sixth is now underway, caused by man, and there is reasonable evidence that it started 20 000 years ago! The disappearance of large mammals such as mammoths in North America and Australasia seems to coincide suspiciously closely with the arrival there of man! Over the recent century or two, it seems to be speeding up, with mankind the almost certain culprit, either directly, such as the dodo, and rainforest destruction, or more indirectly with global warming. After the formal talk finished, the evening then continued with a very enthusiastic free for all discussion of the subject. "A good time was had by all", and lots of old acquaintances were very happily renewed. Thanks go to the members of the Joburg Chapter committee who organized it, and of both Joburg and Pretoria committees who rustled up the attendees.

-- Dave Evans (Chapter Chairman)

Schools Career Seminar

The Johannesburg Chapter held a schools career seminar at the Wits Club on the 12th March.

The seminar, aimed at young mathematically orientated students, presented an overview of Operations Research and the career opportunities available.

Presentations were given by guest speakers, Hans Iltmann and Elsbeth Dixon and by local chapter members Dave Evans and Prof. Paul Fatti. Notably, five past presidents of the Society were involved, including Hans who is currently president for the second time and

Dave Masterson who has also been president twice.

The seminar, which lasted some two hours, covered the origins and basic principles of OR and several typical applications and examples in the fields of sport, wild life conservation and criminology. Also covered, were the human aspects and how to pursue a career in OR.

The event was well attended by both students and teachers from a number of schools in Johannesburg and the surrounding areas and generated keen interest in the topic.

A number of schools in the Johannesburg area had been unable to attend, so it may be repeated this year, as well as becoming something of an "annual event."

-- Stephen Sharpe (Secretary)

Western Cape Chapter

The Western Cape chapter of ORSSA has held three very interesting seminars in 2002 presented by James Bekker (Industrial Engineering, Stellenbosch), Theo Stewart (Statistical Sciences, UCT) and Daan Louw (Centre for International Agricultural Marketing & Development). There is one further seminar planned for the first semester to be presented by Elmiën Wagenaar, which is titled "A mathematical approach towards financial asset allocation strategies".

The second semester will be devoted to hosting a half day workshop on an OR topic, hosting the national conference of ORSSA at Goudini Spa and organising a combined AGM, cocktail party & student competition to find the best 4th year OR project by a student of any tertiary educational institution within the Western Cape. Please diarise the following exciting events:

- 1 *Fourth Seminar*: Wednesday May 29th, 2002
Speaker: Elmiën Wagenaar
Topic: A mathematical approach towards financial asset allocation strategies
Time & Venue: 16:00 in Room A409, Main Engineering Building, University of Stellenbosch, Banhoek Road, Stellenbosch
- 2 *Half day Workshop* (Topic to be announced) on Wednesday October 23rd, 2002 from 09:00-lunch (venue to be announced)
- 3 *National ORSSA Conference*, Sunday September 8th - Wednesday September 11th, 2002 at Goudini Spa (more details may be found on pages 5 and 6 of this newsletter)
- 4 Combined AGM, Cocktail party & Student Competition on Wednesday November 13th, 2002 at the US Graduate School of Business in Bellville.

If you have any enquiries, please feel free to email Jan van Vuuren (chair, Western Cape Chapter of ORSSA) at

vuuren@sun.ac.za



Trying to Capture Dynamic Behavior: A whirlwind tour of industrial applications of mathematical programming

By Laureano F. Escudero.

(Featured in OR/MS today April 2002 - Small World, Big Problems)

This article presents a set of real-life industrial applications of mathematical programming that go from LP and 0-1 programming to combinatorics, network optimization, nonlinear optimization and stochastic programming in the broad area of supplying, production, allocation, distribution, scheduling and dynamic planning. The application cases belong to the strategic, tactical and operational domains.

Description of Applications

Open Market Electric Generation Allocation. The pace of deregulation and the introduction of competition into the energy industry are accelerating globally. The main objective of the electricity market deregulation all over the world is to decrease the cost of electricity through competition. This is achieved through radical changes in the market and regulatory structure, such as the "unbundling" of functions (separation of generation, transmission and distribution segments) and the creation of bid-based electricity markets (see [15] and [19]).

One of the tools that can be used in this new environment is a modeling and algorithmic framework for robust simulation of multi-period hydrothermal power management under uncertainty. The uncertainty involves generators' availability, fuel procurement, transport and stock costs, exogenous water inflow at river basins and energy demand along a given time horizon. Very often there are thousands of constraints and variables for deterministic situations. Given today's optimization state-of-the-art tools, deterministic models should not present major difficulties for problem solving, at least in small environments. However, since the pioneering work of Martin Beale and George Dantzig in the mid-1950s, researchers have recognized that traditional deterministic optimization is not suitable for capturing the truly dynamic behavior of most real-world applications.

A better approach for such situations is to employ two-stage scenario analysis in which an electric generation decision policy, for example, can be implemented for a given set of initial time periods. The solution for the other periods need not be anticipated since it depends on the scenario to occur (see [14]). The "dualization" of the coupling constraints for the splitting control variables of the last period from the first stage results in a quasi-separable Lagrangian function in which Augmented Lagrangian Decomposition (ALD) schemes can be used.

(A multi-stage nonlinear stochastic network approach for hydropower generation optimization is described in [10]. The dualization of the coupling constraints for the scenario groups in each time period along the time horizon allows for an ALD approach. A parallel-computing scheme benefits from the related structure.)

Oil Supply, Transformation and Distribution Planning under Uncertainty. The problem to address is a modeling and algorithmic approach for optimizing the logistics of supplying, transformation and distribution scheduling of oil products under uncertainty. The product is transported from its origin to refineries and storage depots, and from there to destinations over a given time horizon. The goal is to obtain a procurement, transportation and production schedule at a minimum expected cost of raw material supply, transformation, transport and storage. The schedule must satisfy the end-product demand, subject to supply limitations, transformation constraints, transportation mode capacity and stock limitations, and some other logical, technical, economic and regulatory constraints. The complication arises from the data uncertainties due to the fact that the information that will be needed for subsequent stages is not available to the decision-maker when the decision has to be made. The problem then exhibits uncertain supplies and demands as well as uncertain raw material spot prices, refinery productions, stock inventories, and transformation means and transportation mode availability, among others.

The uncertainty is modeled via scenario analysis. It results in a huge LP problem. The model representation is performed by using a splitting variable scheme in a two-stage approach under the non-anticipative principle. A novel scheme for dealing with the multi-stage linking constraints under uncertainty is presented in [16]. The mathematical programming model is amenable for ALD schemes.

In-house Production and Outsourcing Planning via Scenario Analysis. The planning and utilization of production capacity is one of the most important managerial responsibilities in manufacturing. In particular, the problem consists of deciding how much in-house production and how much outsourcing is required at each time period along a planning horizon, such that the production capacity constraints, the product stock limitations and the order backlog requirements are satisfied. Such decisions have to be made in the face of uncertainty in several important parameters, the most important of these unknowns being market demand for the products to be manufactured. The uncertainty is treated via scenario analysis. Several alternatives for a multi-stage case are considered in [13], namely, complete recourse, partial recourse for in-house production, partial recourse for outsourcing and simple recourse. Note that the non-anticipativity principle is preserved for the first three strategies.

Supply Chain Management Under Uncertainty. A two-stage modeling and algorithmic approach for multi-period manufacturing, assembly and distribution supply chain management under uncertainty in product demand and component supplying cost and delivery (among other parameters) has been developed via scenario analysis (see [11]). The supply chain has the following elements: product-cycle time, bills of material, effective periods segment for component assembling, product demand, maximum backlog and stock allowed, production

resources limitation, prime components and replacements, raw components, subassembly and end products, single and multi-level products, in-house production and vendor sourcing, etc. The main goal is to determine the master production schedule as well as the volume and location of protective stock across a manufacturing network for the time periods in the first stage, and for the other periods along the time horizon under each scenario to minimize the regret of wrong decisions. A variety of constraints related to (minimum and maximum) stock limitations, bill of material requirements, production capacity limitations, and demand and backlog requirements are satisfied.

The model approach is based on a splitting first-stage variable representation. Novel schemes are presented for representing the mathematical model. By using the expressions of some variables (say, stock levels, prime components utilization and lost demand) the redundancy of some multi-period related constraints could be detected. The resulting Deterministic Equivalent Model allows for decomposing the problem by using a dual approach for the splitting variable representation. ALD schemes can be used in parallel computing environments. (See [9] for a deterministic version of the problem.)

Given the large-scale dimensions of some instances, an LP algorithmic Sprint-based approach has been developed. In this scheme the constraint-working matrix is updated at each major iteration by appending the violated constraints, relaxing certain non-active constraints, zero-fixing non-promising variables and freeing promising ones. (See [3] for an extension of the model to strategic planning under uncertainty.) The main decision is related to product selection and plant sizing, location and product assignment to minimize the expected profit along a time horizon over the scenarios minus the investment depreciation cost. It has been modeled as a huge mixed 0-1 program. A so-called "Branch-and-Fix Coordination" approach has been developed (see [2]).

Demand Capacity Allocation Planning. Capacity requirement planning is normally based on long-term demand forecasting and part-type mix estimates. In the execution of a production plan, the capacity assumptions previously made are frequently no longer valid. This is because the part-type mix, the operator and the machine availability or the existence of additional resources has changed. This may lead to underload as well as to overload situations for particular time periods. (See [5] for a mixed 0-1 modeling and algorithmic approach for the problem-solving.)

Given the large-scale dimensions of many instances, it is unrealistic to pretend to obtain the optimal solution in affordable computing time. However, a heuristic algorithm, so-called "Fix-and-Relax," is proposed to partially explore the branch-and-cut tree. The approach takes into account all available information at the shop-floor level, such as: machine availability over the planning horizon; unit processing time for the part types; machine set-up time required while changing part types that belong to different families; storable and non-storable resources availability and consumption; part-type demand over the time horizon; and bounds on production rate and backloging. Furthermore, the model correctly accounts for costs corresponding to time-period overlapping set-ups.

Sequential Ordering Problem. The Sequential Ordering Problem consists of finding the appropriate permutation of nodes from a

directed graph such that a given parameter—in our case, the length of the Hamiltonian path—is minimized and certain constraints are satisfied. The main application field lies in the production sector, where a part type is defined as a list of operations to be performed once and, although there is some flexibility in the execution sequence of the operations, there are precedence relationships between the executions of some operations. The goal is to sequence the operations to minimize the "makespan" satisfying the precedence. We can also consider jobs instead of operations, transportation costs instead of set-up costs and release and due dates to be satisfied for given jobs (see [1], [4], [12] and [18]).

Resource-Constrained Operations Sequencing and Scheduling. A pure 0-1 model is the core of an application for production sequencing and scheduling in a deterministic multi-period, multi-task environment (see [8]). The problem consists of determining the scheduling of a set of items (jobs, in our case) to be assigned to a process along a given time horizon (a day, week, month), so that the release and due dates of the items are satisfied. There are a fixed number of time periods during which each item must be assigned (e.g., produced, maintained) along the time horizon.

On the other hand, there is a set of groups of items, and a set of classes of items, such that only one group of items for each class can be assigned. A unique time interval has to be selected for the assignment of each item if its group is selected. The items can also be distributed in different types, such that only one item from each type can be simultaneously in assignment (e.g., only one item can be processed at once in dedicated machines).

Different types of precedence relationships in the assignment of the items are considered. There is a set of resources with limited availability along the time horizon. The items may require a different amount of the resources in each of their production time periods. The goal consists of determining a feasible schedule for the item assignment to minimize the given objective function. Different alternative functions are considered, namely, the makespan and the total assignment cost.

This type of problems can frame such different applications as energy generators [6] and other production units [7] maintenance scheduling, projects selection and "periodification" [17] and, obviously, operations sequencing and scheduling. From a practical point of view, and due to its combinatorial nature, the problem cannot be solved up to optimality in affordable computing time for large-scale instances, but efficient heuristic approaches are used.

The applications described above are from the following sectors: electric generation and trading, automotive manufacturing, computer manufacturing, gas, chemical and oil procurement and logistics, maintenance planning, capacity production expansion and investment planning. In general, most of the results can be applied to other sectors as well.

Logistics planning (procurement, production, allocation, and distribution planning and scheduling) is one of the common features for all applications. On the other hand, all of them also share a dynamic component, i.e., most of the constraints and variables are time indexed along a time horizon.

.Most of the applications have uncertain data, e.g., raw material

cost, transport time and means availability, product demand and price, resources availability, nature-related parameters such as water exogenous inflow, etc. Some sort of risk management is needed. Some applications have 0-1 variables, i.e., the so-called decision variables. Interesting enough, there is only one deterministic LP application.

The hydrothermal power generation planning is the only application that has nonlinear relationships among the variables. The nonlinearity is due to the hydropower generation functions.

Finally, the applications are large in scale, which means it is not realistic to seek optimal solutions, especially for the stochastic cases where the uncertainty is represented by a set of scenarios.

In terms of technical features, many of the applications outlined above have uncertain parameters in the objective function. The stochastic approach that has been used for dealing with the uncertainty of the parameters is based on scenario analysis. Moreover, the selection of the representative set of scenarios is still an open problem.

A splitting variable representation for the Deterministic Equivalent Model of the stochastic problem is proposed for this type of applications. This representation uses a coupling constraint scheme either for linking the scenario submodels or for linking the submodels related to the scenario groups from each stage along the time horizon. It is very amenable for using ALD approaches. Note that the submodel constraint matrix does not vary from one scenario to another and, so, the devices for model generation and initial solution building benefit from it.

There are several huge 0-1 dynamic models. A heuristic algorithm—the so-called Fix-and-Relax—has been proposed to partially explore the branch-and-cut tree for obtaining good solutions in the deterministic environments. On the other hand, an exact algorithm—the so-called Branch-and-Fix Coordination—has been proposed to coordinate the execution of the scenario-related branching phases for stochastic 0-1 models.

Most of the applications require inter-disciplinary OR teams with skills in different disciplines such as mathematical programming modeling, probability, scenario generation, artificial neural networks, cluster analysis and Monte Carlo simulation, among others. Several applications present algorithmic schemes for parallel optimization based on PC clusters. Some others are well suited for being implemented in parallel computing environments.

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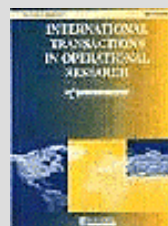
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