OR NEWSLETTER

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EDITORIAL

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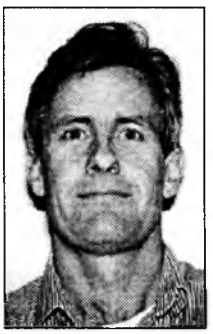

I recently attended a seminar by Lukas Visagie of the Operational Research Society of South Africa, which addressed some of the difficulties facing the OR profession in South Africa. Part of the thesis espoused by Lukas was that OR in South Africa had lost direction, through an inability to establish its position in a market which accommodates all of the possible manifestations which business and management service industries can take. In essence, OR in South Africa had a brand-awareness problem, brought about by an inability for its Society to define the discipline clearly and market it effectively. The realm of the discipline was being invaded by consultants of every shade and hue, with no allegiance to, or even awareness of, Operational Research. These concerns are not peculiar to South Africa; the May 1996 issue of the JORS Newsletter outlines preliminary proposals by the UK Society to establish a professional membership status for Operational Research practitioners, so as to serve as a means of guaranteeing good workmanship for clients, as well as sharpening the image of OR.

So should we also be raising concerns like these in ORSNZ? I seem to remember some comments at the 1995 Conference about the threat to OR from fields such as computer science, but these did not seem to be taken very seriously by most members. Are we being short-sighted here?

First of all, it is interesting to speculate on why New Zealand practitioners on the whole do not feel threatened by other disciplines. My hypothesis is that most OR/MS activity in New Zealand has traditionally been concerned with situations which have been treated with mathematical models requiring some level of technical competence, either in statistics, stochastic processes, or optimization. In my view, this is partly because, in its early days, OR/MS in New Zealand developed in universities and the AMD group of DSIR, and so has developed a culture based on the development of new mathematical techniques and their application. More recently the technical side of the subject has been rejuvenated by advances in computer technology, which mean that the implementation of previously intractable models is now possible. My point is that in New Zealand, OR/MS has been defined by its successes using technical expertise. So we should not (and in fact do not) feel particularly threatened by, say, a competitor properly applying a linear programming

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model, since they are doing what we recognize as OR, albeit under a different name.

The perceived threat, I conjecture, comes at the so-called "soft" end of the discipline. Here it is more difficult to identify if an individual has the right stuff to be called an OR practitioner. It is not clear whether having some tertiary qualification is an adequate signal in this context. The education required to address poorly structured problems can be gained to some extent in a formal setting – how to impart this education is a big challenge for OR/MS academics – but, in my view, most of it is acquired in the University of Life. (I must confess to being unable to make a well-informed judgement of management education in this context, but it often appears to me that management theories are, perhaps necessarily, based on observations of what seems to be current practice, rather than on analysis.) Consequently, it is difficult for companies to assess whether they should hire the consultant calling herself a Business Consultant, or her competitor who claims expertise in OR/MS. In summary, the technical tools of the OR/MS trade acquired (in most cases) through some form of tertiary qualification, can serve to identify members of the OR/MS profession; on the other hand, the soft side of OR/MS has less recognizable calling cards.

On a philosophical level, I think that all of us involved in OR/MS would be unwilling to define the discipline simply in terms of its techniques. So I hope to be forgiven for appearing to advocate this. However definitions are sometimes unhelpful when trying to make a sale. My definition of OR/MS is "quantitative problem solving", but using this definition does not help market the discipline to its potential clients, or identify the great contributions that OR/MS can make. The reputation of OR/MS I believe comes from its track record. This ultimately rests not in some of its simple manifestations, such as, say, trivial spreadsheet calculations, but in its contribution towards solving or understanding situations of considerable complexity. In most cases these situations require sophisticated techniques, and it is in the ability to develop and apply these techniques that OR/MS can expect to preserve its comparative advantage over other competing disciplines. Indeed as the so-called "information" revolution continues to deluge us with data, we will all come to rely on the tools of OR/MS to filter the information from the flood.

The prescription for OR/MS is clear. On the academic side we need to provide our graduating students with state-of-the-art OR/MS techniques. My view, which I am sure is not shared by all readers, is that these techniques should form the core of an OR/MS curriculum, and be supported by example applications, contrived if they need to be, which give tangible results (like an optimal solution) to reinforce the student's confidence and enjoyment. The learning experience gained by a first-year student applying a nontrivial technique to a relatively complicated example is in my view more valuable than his endeavours applying common sense to try and model a poorly structured problem. Of course providing people with the ability and confidence to attack such problems is important, and we would be short-changing our students if we let them graduate thinking that OR/MS is just the simplex algorithm. On the other hand, successful OR/MS modelling requires experience of the world, as well as some intellectual framework with which to structure this experience, so, until some measure of both of these have been acquired, OR/MS case studies and open-ended OR/MS projects should not be a major part of our academic programmes.

Is there a presciption for practitioners of OR/MS? If they want to establish or preserve an advantage over other competing disciplines, then they must in my view be one step ahead of the competition. This means tackling the complex problems for which common sense and logic are not enough to yield a good answer. It also means staying in touch with advances in modelling methodology and algorithms. Of course, there will always be a delay in the adoption of new methods in practice – it is not usually cost effective for practitioners to develop and implement a complicated algorithm from scratch. For example, before the development of modelling languages like GAMS and AMPL, few companies would consider the considerable expense of commissioning a purpose-built branch-and-bound code. But the accessibility of these methods has improved, along with theoretical understanding, to the point where they can be implemented relatively routinely by practitioners. An important observation to make in this case is that the efficacy of the algorithm can rely critically on the formulation, a fact that should be taught in any OR/MS course on mathematical programming. It is from knowledge of this type that the practitioner of OR/MS derives a competitive advantage.

In conclusion, let us concur that we should all be "quantitative solvers" addressing the broad range of problems which arise in OR/MS. We should also make use of common sense as a modelling tool when appropriate. However, let me advocate that we should resist promoting applied common sense as our main modus operandi. Instead we should promote OR/MS by our successful endeavours to tackle challenging problems, which are too complicated to model using a simplistic approach, and promulgate the idea that OR/MS is a discipline that can make significant contributions to decision making in complex circumstances.

MORST ANALYSIS OF NZ'S SCIENTIFIC KNOWLEDGE BASE

Earlier this year, The Ministry of Research, Science & Technology launched a project to describe and analyse New Zealand's knowledge base in order to bring a 'fresh science-based perspective' to the management of public investment in science. The first step was to build a concise and comprehensive **profile of NZ science**, to inform the general public and those directly concerned with making decisions on public science funding of where NZ science is at. Professor David Ryan from the Department of Engineering Science at the University of Auckland was asked to serve as profile author for **Operations Research**. I consider that it is of sufficient general interest, both in terms of the current state of OR in NZ, but also on its historical development, to be reprinted in full below.

The Editor

AREA PROFILE: OPERATIONS RESEARCH

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1. Introduction

Operations Research is a relatively young subject which involves the application of scientific methods to solve a wide variety of decision problems occurring mainly in business and industry. The problems often involve decisions about the optimal or efficient use of scarce or valuable resources. Many of the methods of Operations Research are based on the development of mathematical models and the associated solution algorithms for these models. In this sense, Operations Research can be considered as a branch of the mathematical sciences, but since the applications occur in business and industry, the ultimate impact of the subject should be assessed in the context of these problems and applications. In fact Operations Research should be considered as an interdisciplinary subject with important links and connections to the mathematical areas of optimization, probability and statistics, and discrete mathematics, as well as the other subject areas of economics, finance, engineering, management, and computer science. The importance of the practical application is a distinguishing feature of the subject of Operations Research, and research usually involves the modification, extension and adaption of both models and solution methods to solve specific problems. Besides its links to areas of mathematics, the subject also includes methods of a more subjective nature; in this profile we focus on the more quantitative or mathematical aspects of Operations Research.

Mathematical Programming is one of the most important areas of mathematics associated with Operations Research. Fundamental research in mathematical programming is often undertaken without the motivation of applications, and the importance of such work is often recognised by its subsequent use in the context of Operations Research.

Computers play an essential role in research activities since most important practical applications give rise to models which can only be solved with significant computer power. Major advances have resulted from the rapid increase in computational power.

The omission of Operations Research in the proposed subject classification is perhaps not surprising if the classification originated in Australia. Research activity in Operations Research has for many years been much more prominent and successful in New Zealand than in Australia. It is interesting to note that the recent review of Mathematical Sciences in Australia (Mathematical Sciences: Adding to Australia, Australian Government Publishing Service, 1996) identified "a significant weakness in the research framework underpinning Operations Research" and recommended as its second specific recommendation that "The Australian Research Council be encouraged to designate the field of Operations Research as a priority area for ARC grants, particularly as a Key Centre of Teaching and Research".

2. New Zealand's Knowledge Base

2.1 Historical Overview

The development of Operations Research in New Zealand was pioneered during the mid 1960s by an active OR group within the old Applied Mathematics Division of DSIR and by a small number of individuals at Auckland, Victoria and Canterbury Universities. (In acknowledging the important pioneering role of the OR Group in the DSIR, it is very sad to record that the activities of this group have recently been terminated in IRL). The interdisciplinary nature of the subject is reflected in more recent developments with active researchers now working in the application areas of

management, statistics and engineering and forestry with relatively few persons working directly in mathematics. A special feature of the subject development and the underlying research in New Zealand can be identified in the focus on, and successful solution of, important practical problems involving applications of both national and international importance. For example, the work in Energy Modelling and Air-Crew Scheduling, discussed in more detail in Section 2.2, has attracted international attention and has had a significant impact in those application areas in New Zealand. Research has been and continues to be motivated by the need to solve these difficult practical problems. This can be contrasted with the emphasis on more theoretical research amongst most of the international OR community, particularly in the US. Amongst the current researchers in the subject, there are a number who have international reputations in their own areas of expertise, and their contributions have received international recognition.

For many years the Operational Research Society of New Zealand has provided a focus for activities in the subject by holding an annual conference which has attracted participation from both researchers and representatives of business and industry. The papers presented at these meetings reflect the success of OR activities in New Zealand.

2.2 Strengths

In assessing the strengths of Operations Research in New Zealand, one can identify a number of application areas in which important research contributions have been made. In some cases the research has had a significant impact in New Zealand. Contributions can be classified by application area or by methodology. We have chosen to present the following classification of research contributions by application with reference where appropriate to innovation in areas of methodology.

- Economic systems modelling: Significant research work associated with the development of economic equilibrium models has been carried out at Victoria University of Wellington. The underlying modelling work has obvious connections to areas of operations research, such as optimization and simulation. Much of this work is of distinct New Zealand character since it is based on the special features of the New Zealand economy.
- Energy modelling: There have been significant advances in research on models and techniques in the energy sector, in particular for optimal electricity generation and dispatch. This research has been carried out in the Energy Modelling Research Group at the University of Canterbury and in more recent times also at the University of Auckland. The uniqueness of New Zealand's hydro-thermal system has required the development of innovative optimization methods for scheduling power generation. These include discrete optimization techniques for the short-term unit commitment problems and stochastic dual dynamic programming for long-term reservoir planning. Recent research has focussed on the development of models for designing a deregulated electricity market and investigating its implications.
- Forestry: The Forest Research Institute and more recently Auckland and Canterbury Universities have been involved in the development of Operations Research models covering most areas of forestry from harvest planning to logging operations to timber milling. Much of the research has been based on the innovative use of optimization models and methods, but heuristics have also played an important part in the work. This work has distinct New Zealand character and has attracted international attention.
- Production Scheduling: Research at the Universities of Auckland, Canterbury and Waikato has focussed on issues of inventory and production scheduling. This work has led to new heuristic methods for problems, including stochastic parallel machine scheduling, scheduling with controllable processing times and costs, early-tardy scheduling models, and project scheduling with a stochastic evolution structure.
- Personnel Scheduling: Significant research in the application areas of crew and staff scheduling and rostering has been carried out during the past decade mainly at the University of Auckland. New Zealand contributions to the solution methods for set partitioning optimization have made it possible to solve massive set partitioning models which arise in staff scheduling and rostering applications, and these advances have had an important impact in the development of planning and rostering methods at Air New Zealand and in a number of other New Zealand organisations.
- Telecommunications: Research into telecommunications models has proceeded on two fronts. There have been significant methodological contributions made in the area of stochastic queueing networks and their behaviour. The study of these is important for developing and testing routing strategies for voice and data communications networks. Significant advances have also been made in the development of optimization techniques for designing local access networks for voice, data and video transmission.

- Transportation: Research into vehicle scheduling and fleet deployment, using both heuristic methods and methods based on generalised assignment models, have enabled the development of decision support systems for the routing of large vehicle fleets.

2.3 Distinctive New Zealand Character

Five areas of research activity during the past ten years have had a distinct New Zealand character.

- Economic systems modelling: The economic systems modelling work has been of particular relevance to New Zealand because of the open nature of the economy and its dependence on overseas trade.
- Energy modelling: The New Zealand electricity generation system is significantly different from overseas systems because of its high reliance on hydro generation, the Cook Strait DC cable and the inability to import power from abroad in the case of shortfall. Because of these features, considerable research has been devoted to the development of models and solution techniques to schedule power generation from stations on a river chain as well as models for ensuring security and efficiency of electricity supply in the long term.
- Forestry : Since forestry is an important component of the New Zealand economy, it offers important opportunities for the application of Operations Research methods. The Forest Research Institute in Rotorua has made a major contribution for more than ten years in many areas and their work is recognised internationally. More recently, research at the Universities of Auckland and Canterbury has focussed on more detailed modelling involving short and medium term harvest scheduling, log bucking, truck dispatch for logging operations, and log-breakdown models for optimal timber production.
- Personnel Scheduling: Research in the area of personnel scheduling and rostering has been carried out in collaboration with Air New Zealand and has resulted in the airline being amongst the first airlines worldwide to successfully implement optimization based methods for both planning and rostering.
- Transportation: Vehicle scheduling research has been motivated by practical problems arising in the New Zealand dairy and petroleum industries. The methods developed in this research are being used by a number of organisations in New Zealand.

2.4 Gaps in the Knowledge Base

Areas in which there is a recognised gap in technical expertise include simulation, control processes, maintenance and reliability and polyhedral combinatorics. While each of these areas could be considered important, such judgements should be made in the context of potential applications in New Zealand.

3. New Zealand's Capability

In the field of Operations Research there are two main groups at the Universities of Auckland and Canterbury. Smaller groups exist at Waikato, Massey and Victoria Universities and also at the Forest Research Institute. Isolated individuals with research interests in Operations Research also exist at other universities. Although little research is undertaken outside the Universities and FRI, strong collaboration with companies and industries has provided important motivation for research and has resulted in many successful applications of the subject in New Zealand. Collaboration with outside organisations (such as Air New Zealand, ECNZ and Telecom) has also provided many opportunities for postgraduate research at both Masters and PhD level, and this has resulted in strong graduate programmes at both Auckland and Canterbury.

In contrast to many other countries, there has been an obvious commitment in New Zealand to undertake research motivated by real practical applications. Despite its past success in this area, the termination of the activities of the Operations Research Group at Industrial Research Ltd has resulted in a serious decrease in the opportunities to make contact with New Zealand business and industry. This is to be regretted. The termination of the activities of the IRL Group may be related to issues of research funding.

Because of the interdisciplinary and practical nature of the subject there is serious concern that public funding of research activities in Operations Research is not well supported. Classifications of research areas seldom include Operations Research and applicants for research funding have been advised that because of the practical or commercial implications of research proposals, they should instead seek funding from private business or industry. While in some circumstances such funding may be available, it is unfortunately true that private enterprise is seldom inclined to fund research which is not of immediate commercial value. This is especially true if the proposal involves significant underlying research and development. A similar situation has existed in Australia and this has been highlighted in the recent review of Mathematical Sciences in Australia.

4. Opportunities

Areas in which there is further opportunity for the development and application of Operations Research methods include transportation, health, agriculture/horticulture, finance and risk management, engineering design, public policy OR, and the environment. Some contributions have been made in each of these areas, but success has been limited. Often the limitations are due to the lack of communication between researchers and key personnel in the application areas. Such links with business and industry are vital for successful research activity. The establishment of these links has relied on the commitment of a small number of researchers and the willingness of business and industry leaders to participate in such research and development projects.

5. Conclusion

For a country of New Zealand's size, the research output of our small Operations Research activity has had significant impact. In a number of application areas highlighted above, the subject has made significant contributions to New Zealand business and industry, and the underlying models and methodology developments have attracted international recognition in a number of areas.

The most important needs in the area of Operations Research are to further develop links with businesses and industries to provide practical motivation for research and to establish proper avenues for the funding of underlying research through public funding agencies.

STOCHASTIC PROGRAMMING:
Interview with Professor Birge

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Professor John R. Birge of the University of Michigan visited the University of Auckland from August 15th to August 22nd, as a guest of the University of Auckland Foundation. Professor Birge is Chair of the Department of Industrial and Operations Engineering at the University of Michigan, and is a world-renowned expert on models and methods for decision making under uncertainty. Professor Birge has applied such models to problems arising in electric power systems, finance, transportation, and manufacturing, and made major theoretical contributions to the field of stochastic programming. Professor Birge is Editor-in-Chief of the international journal *Mathematical Programming, Series B*, and Associate Editor of a large number of prestigious international journals. He gave three seminars while in Auckland, and I interviewed him for the ORSNZ Newsletter. The transcript of this interview follows.

GZ: How did you start your work in Stochastic Programming (SP)?

JRB: I was working at Stanford with George Dantzig and he had a model called PILOT; it was an energy model and he wanted to include into it probabilities of disruptions, like the oil embargo, and that's how I got interested. Actually the other thing was that Dantzig gave a talk when I first got there. He drew a diagram showing Stochastic and Deterministic and Static and Dynamic where he wrote the names of the people who had worked in each area, and he said that the Stochastic Dynamic area hardly anyone has worked in, so I thought maybe that is an area I ought to work in. So it was these two things. The problem we had and the open area.

GZ: What was it like being supervised by George Dantzig?

JRB: I enjoyed working with Dantzig. He is a good advisor if you really know what you want to do. He has tremendous insight, so when he would tell me "I'm not sure if that works" I knew I had to go back and check it, or if said "yeah, this looks like a good approach" then that meant OK, that is what I should try. I enjoyed it a lot, to me he was ideal.

GZ: Could you mention and explain some of your results that had a big impact on the field?

JRB: The one thing that I did for my thesis was to create the concept of 'Value of Stochastic Solution'. It showed how just having a stochastic model can make a difference. It is not the same thing as the expected value of perfect information and may be more relevant than the the expected value of perfect information which you might not be able to collect as data. So it's a good measure for certain modeling capabilities. I have also done work in decomposition,

computation and bounds for a Stochastic Programming, and interior point methods, and other types of models.

GZ: What is the current status of stochastic programming vis-à-vis US industries? Is it used as a standard tool?

JRB: I don't think it's a standard tool. I think it's being used more than in the past. A lot more people are interested in it and aware of it. Before people thought it couldn't be used because the models were too complex, but as we're able to solve bigger models, then it comes into practice.

GZ: So is the ability to solve more complex models a result of new techniques or technology, or both?

JRB: Both of them.

GZ: Do you perceive SP as an appropriate technique for the finance industry and has there been any quantitative advances based on SP in that industry (e.g., Wall Street)?

JRB: There are a number of people using SPs in Wall Street in Asset Liability Management and also in Fund Management. I think it's become popular. Some people, like Ron Dembo's company, sell software in Wall Street, they solve SPs mainly dealing with Fund Management. There are some other people who do Asset Liability Management. These are problems where in the past people used heuristics or very gross approximations, and they were missing things, such as not matching an asset or not matching their liabilities exactly. So Stochastic Programs actually help do that better.

GZ: What are the main unsolved problems in Stochastic Programming?

JRB: Well, I think in general just finding the expectation of a multi-dimensional integral that involves another optimization problem. There are no techniques that work in all circumstances, so that's a general problem. Now there are some results, Quasi Monte Carlo results, that say there are good asymptotic bounds, but I think there needs to be a lot more work to get more information on when those bounds actually apply. I think other things involve Stochastic Integer Programs. There is a limited set of SIPs that have been solved, and there is a lot of work there that could be done on how to solve those problems. I think of the area of continuous time problems: how to merge SP with ideas from, say, Stochastic Control, is an area where a lot more work could be done. And I guess nonlinear problems. There hasn't been that much work, so there is probably room for taking advantage of Stochastic Programming structures in nonlinear problems. The way most people do them now is they just solve the deterministic equivalent. Theoretically there are also questions about what happens asymptotically in SPs solution with sampling; for example, there aren't really any results, like if you sample a problem and the optimum is not unique, then what is the asymtotic distribution of the sampled optima? There's no theory there, so that's an open question, and even when it's known, it's not clear how you can compute that distribution,or how you can use confidence intervals.

GZ: What is your feeling about the future direction of Stochastic Programming?

JRB: Well, I think a lot of it is going to be oriented towards applications. So I would say a broader range of applications. Then the other thing would be, say, modeling interfaces that make it easy to create models. As it is now, it requires a high degree of expertise to create a Stochastic Programming model. So I think there will probably be a lot of work in terms of automating that process to make it easier to actually create a Stochastic Program.

GZ: There is a school of thought that believes Operations Research is too theoretical in America. What is your view?

JRB: Well, there is some work in OR which is quite theoretical. I think there has been a trend away from that recently. I don't think the biggest problem is whether there is too much theory. I think a bigger problem is when people are working on problems that aren't really proper applications. They may seem practical, but they're not; they don't really exist. To me, people

are doing too much of making up a problem that doesn't really exist and trying to solve it. That's not really theory, it's supposed to be applied work, but it's not an true application. I think the other problem is just that there is a lot of marginal improvements and not really bold, new stuff. Sort of a security of the past which is easy to get trapped into.

GZ: In your opinion, what are the key ingredients in an OR curriculum and what should be the proportions?

JRB: I think it's important for an OR curriculum to have certain amount of the foundations which are optimization, stochastic modeling, and I think every OR student should have a basic background in these primaries. I think every student should have some application that they are familiar with in context of the models that they work on, and beyond that I think it's mainly up to the individual. One other area that I think a lot of OR practitioners need more of is statistics. They need an understanding of statistics to create models. That's the basis for the parameters they use in the models. Otherwise I think that the program should be fairly flexible in letting the students to choose their own areas of specialization.

GZ: What do you believe are the advantages and disadvantages of having a department of Operations Research in a school of Engineering?

JRB: The advantage in the school of Engineering is that you're immersed in applications, and there is at least the potential for interaction with other engineers. A disadvantage is that in the US we are not perceived as being engineers, and we don't have the ability or need for grant funding, and there is perhaps a lack of appreciation of theory. There are very few OR departments that can exist within a business school [in the US] since it's perhaps not of immediate relevance to MBAs. I think in math departments it can do well if the math department recognizes the value of application,s and there may not be that many of them. Our department has done well because we try to work with people in Engineering and maintain ties with math and business school.

MODELLING ON TRIAL:
Using OR/Statistics Models in Litigation

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Quite by chance in the last few weeks I have come across two applications of OR/Statistics in an area that I would not have thought of – litigation. In both cases modelling was being used to back up one side in a court case.

In one instance (related to me by an MBA) , a company was trying to prove fraud by an employee and part of the evidence was a statistical analysis to show that the employee's actions were significantly different from what would be expected. In the other example, now being published, a contractor who was working on the Channel Tunnel was sued for contract overruns in both time and cost. The contractor claimed that this was mainly because of many last minute changes to the specifications and was, therefore, not the contractor's fault. A model was built to map the history of the project, firstly using cognitive mapping and then transferring into systems dynamics. This latter model was supposed to represent accurately what actually happened. In this example, the case was settled satisfactorily out of court partly, it is believed, because of the modelling evidence.

This particular application of modelling seems very interesting to me – especially if the cases get to court. Can you imagine having to stand up and defend one of your models, and all its possibly questionable assumptions, against a smart lawyer trying to discredit it? I, for one, would be quite nervous of doing this, but one could argue that OR models that have significant implications and consequences should be put through just such a process of critique.

Anyway, my interest has now been aroused and I would like to conduct a survey of the general use of modelling in litigation. Is it very common or quite rare? Is it becoming more common in this increasingly litigious world? Can we develop guidelines for good practice to help people who find themselves and their models on trial? If you are aware of any examples of modelling being used in litigation, or any studies or surveys, please let me know at the above e-mail or postal address.

ON "TECHNOLOGIZING" MANAGEMENT EDUCATION

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In the last twenty years the world has seen a change in the way technology has impacted society. Before this modern epoch of an "Information Society", technology was utilized for a specific purpose. The simplicity of the technological applications allowed for a complete understanding of the ramifications. Even a relatively complex technology, such as a precision timepiece, was understandable in its general effect. However, some technologies, it can be argued, are responsible for greater effects than intended. In America, the advent of a mass produced and affordable automobile was thought, by some, to be the major cause in the rise of the birthrate.

We are observing, in our present decade an important technological convergence; that is, the coming together of computing and communication technologies. The potential impact of this technological convergence is significant and likely to exceed our often modest expectations.

How does this concern management education? The technological convergence of computing and communication technologies – its most notable and publicly visible offspring to date being the Internet – makes information very accessible. Perhaps it is like automatic teller machines; it is now very easy to get your money out when you want to. At least two New Zealand universities, that I am aware of, are teaching courses completely over the Internet. There is pressure to technologize management (read OR, given the flavour of this newsletter) education.

But what does this mean? What are the impacts of such technologizing? Can it stimulate deeper, as opposed to surface, learning? As a university teacher I see the necessity of using technology to support my teaching (if for no other reason than that students will be using such technology in the workplace), but that use of technology is mixed with a large measure of caution. My anecdotal evidence suggests that the multimedia approach of turning a course, or part of one, into an interactive experience can be a lot of work with relatively small marginal benefits. Much greater benefit can be gained, in my view, by exploiting the asynchronous communication opportunities afforded by the Internet; what we usually refer to as email. Last year I was a silent (but invited) observer of a group of five working men, who were studying for a distance MBA qualification. They were located in both New Zealand and Australia, and their not inconsiderable interaction and willing contribution of their own material greatly enhanced their collective learning – they all passed! In our large, first year Management Systems course at the University of Waikato, students are required to work in small "buzz" groups. One of their greatest challenges (aside from motivation) is to find a time to meet together. Synchronous communication is difficult and writing letters is too slow. E-mail is a viable alternative.

I resist the demand from students for stimulation, wherein "bright and loud is better". Teachers will increasingly make use of technology in education, with some real benefits. But the effects are less well known, and a good many of the costs of so doing are hidden. And what of managers and practitioners? A recurring phrase is that of "perpetual learning" – of people who keep on actively learning. How can information technology support this? It certainly provides the means to disseminate and communicate information. Perhaps the role of the educator will, as Don Norris from George Mason University said to me the other day, become more of synthesis; of pulling together the vast amount of information available and providing useable chunks or snippets for the perpetual learner.

THE UK SYSTEMS SOCIETY

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Hi, I am just reaching the end of a very enjoyable stay in New Zealand. I have been on six months study leave from Warwick University, UK, where I lecture in OR and Systems. I have been hosted by Hans Daellenbach at the University of Canterbury. I, and my family, have found NZ to be a really beautiful and interesting place and have found people very welcoming. We got round many, but not all, of the sights, and I managed to visit most of the universities.

I am actually writing this note about a society of which I am currently the Chair – the UK Systems Society. The UKSS is fairly small, about 300 members, and aims to promote the development of systems ideas in theory and in practical decision making. Although it is called the UK society, it is actually international in character with about 40% of its membership from outside the UK. Its main activities at the moment are a quarterly journal - *The Systemist* - that is free to

members, and a biennial international conference. The next conference will be held in Milton Keynes in July 1997 and the theme is "Systems for Sustainability: People, Organizations and Environments". For details contact Prof. Ray Ison, Systems Department, Open University, Milton Keynes MK7 6AA, *e-mail: r.l.ison@open.ac.uk.*

In my time as Chair I hope to expand the activities and membership of the Society, and to this end we are inviting feedback as to what would make the Society more effective and attractive for members and potential members. Below is the text of my first Chair's Report published in Systemist in March:

Chairperson's Report: March 1996

Kia Ora, as they say over here in New Zealand, from where I am writing my first report as Chair of the UK Systems Society. I am lucky enough to be enjoying six months study (January to June) leave at the University of Canterbury, Christchurch, and so am basking in sunshine rather than snow!

I would first like to thank Keith Ellis, the departing Chair, for the good work that he did during his office, for organising such a successful conference, and for leaving the Society in a very healthy state. The membership and finances look healthy, conferences are increasingly successful, and *The Systemist* is developing a reputation way beyond its humble newsletter origins. A point at which there are possibilities for the Society to take on a much more major role in the development of systems ideas both in the academic world, and in practice.

Systems thinking has been developing as a definable body of ideas for some fifty years now. After a very stimulating and hopeful start in the 40's and 50's, I feel that the impetus fell away somewhat as the limitations of hard systems thinking were recognised both in academic disciplines (e.g., functionalism in sociology) and in management and organisational intervention. However, in the last decade much progress has been made, for example in cybernetics (with second order cybernetics and particularly theories of self-reference and autopoiesis), in intervention methodologies (SSM and critical systems), and in information systems. We have now reached a moment when there is, and will be, a resurgence of interest in the use of systems ideas in other disciplines such as sociology and philosophy, as well as in more traditional areas such as management, ecology and so on. I believe that we, as informed systems people, will find ourselves more in demand, and much less marginalised, in the future than we have been recently.

If this analysis is correct, then the UKSS can play an important role in facilitating its members to make use of these opportunities, and in promoting both the development and spread of systems theory and practice. What this requires is that the Society, through its Committee, undertakes a thorough review of its medium term strategy and becomes more proactive in its activities. We have been very successful so far, but in only a small number of activities - the Conference, *The Systemist,* and a number of seminars run at Warwick. What we need to do is define clearly our strategy and then focus on a number of activities or ventures that will be of interest to current members, will promote systems ideas, and will thereby widen our membership in the future. This is the main task that I will pursue during my tenure as Chair.

In practical terms, we, the Committee, intend to hold special sessions later in the year at which we will formulate our strategy and develop a range of possible activities for the Society to be considered by the membership. We would very much like some help in this by way of input. What are your views on what should be the aims or mission of the Society; what particular objectives we should pursue in the next five to ten years; and what specific activities we should undertake in support of these objectives? We even have an accumulated surplus of some £8,000 available to support such activities. We are aware that both the membership and the committee are biased towards the management/IS end of the systems spectrum, so we would be particularly interested to hear from those of you who develop and use systems ideas in other domains and disciplines.

So, could I ask as many of you as possible to send in your ideas on anything from particular types of activities or ways of spending money through to general mission statements for the Society as a whole. You can send them to me either by email:

j.mingers@warwick.ac.uk
or to: *Warwick Business School, Warwick University Coventry CV4 7AL, U.K.*
I hope that we can all promote both systems thinking and the UKSS in the next few years.

Please get in touch with me if you want further information about the UKSS or to offer ideas as to initiatives that the Society might undertake. I look forward to returning sometime to NZ and visiting the parts that I missed this time.

RESEARCH AT THE DEPARTMENT OF MANAGEMENT SYSTEMS AT THE UNIVERSITY OF WAIKATO

Les Foulds, Department of Management Systems, University of Waikato, Hamilton
e-mail: l.foulds@waikato.ac.nz

Current Research

1. Multicriteria decision making

In the context of multicriteria decision making, different methodological approaches to individual decision making, using laboratory experiments, have been performed. Evidence suggests considerable differences among approaches in terms of decision quality and preference for use; and these two are often not well correlated. The challenge is to acknowledge and incorporate the behavioural aspects of decision making into new hybrid techniques without forsaking the normative or ideal approaches.

There has also been considerable joint work done by the Department of Strategic Management & Leadership and our Systems group (both in the School of Management Studies), on an investigation into the use of OR tools and their impact on strategic management.

2. Vehicle fleet deployment

Over the last ten years the Department has developed and refined a user-friendly, menu driven, decision support system which is designed to aid experienced milk tanker schedulers of New Zealand dairy companies, in the deployment of their vehicle fleets. A number of theoretical aspects have been researched and published, including: vehicle scheduling on tree-like networks, generalized assignment problem models, specialised machine sequencing models for pump scheduling, and techniques for assignment problems with side constraints. A separate project in this area concerns the use of queuing theory and simulation techniques to promote more effective use of the vehicle fleets of public service organisations.

3. World class operations

These endeavours concern the formulation and solution techniques for models concerned with flexible manufacturing systems, machine scheduling with controllable processing times and compression costs, project scheduling with resource constraints, a new unified approach to group technology, studies into the utility of world class manufacturing techniques, time-based competition, the application of goal programming in artificial breeding, and facilities planning.

4. OR Education

Detailed experiments (in classes offered by the Department of Management Systems) into the value of student-centred and independent learning approaches to the teaching and learning of OR have been carried out.

Work with a New Zealand character

Much of the above work is of a New Zealand character, especially the research into vehicle fleet deployment. The vehicle routing decision support system mentioned above is currently in practical use in three New Zealand dairy companies and is being continuously developed and refined. It is in the process of being applied within the New Zealand oil industry. Techniques developed for effective vehicle fleet utilization were successfully adopted by a New Zealand regional electricity supply authority.

Three world class operations projects have a distinct New Zealand character. Firstly, there has been a comprehensive study, which was completed recently, on the use of world class manufacturing techniques within New Zealand industry. A second recent study investigated the viability of the concepts and techniques of time-based competition within New Zealand organisations. A third project involved the development of goal programming models and techniques for the rostering of bulls used in an artificial breeding programme. The output of this research was applied successfully at a New Zealand livestock improvement agency.

The project on student-centred learning has a definite New Zealand character, as the experiments have all been carried out in our department.

A proposed project has recently received seeding funding to investigate prescriptive multicriteria decision making tools in New Zealand organizations. The research into the viability of OR tools in strategic management resulted in a large study of both New Zealand and British organizations in order to investigate the use of these tools in the two countries.

Further details of the above work are available in the Department's Research Reports. Please see the Department's WWW home page: *http://www.mngt.waikato.ac.nz/systems/home.htm*

BRANCH GOSSIP COLUMNS

Symonds Street Stories – Auckland

Golbon Zakeri, Department of Engineering Science, University of Auckland, Auckland
e-mail: g.zakeri@auckland.ac.nz

This year we have been fortunate to have visits from leaders in OR such as Professor George Nemhauser of Georgia Tech, Professor John Birge of the University of Michigan, Professor Gerd Infanger of Stanford University, and Professor Jose Ventura of Penn State.

Last September two of our master's graduates, Mike O'Sullivan and James Deaker, started their PhD work at the prestigious Stanford University. Mark Smith joined RHE & Associates after completing his master's to take up a software Engineering position.

Most of our master's students will be leaving us this September. Kevin Broad (last year's YPP winner) will be practicing his OR skills at CORE. Ian Bowden will be joining Coopers & Lybrand but not before his extensive trip to the middle east and central Europe. Sonya Rennie will be joining the Boston Consulting Group after her travels in the US and Europe. Hamish Waterer is off to Georgia Tech to work with Professor George Nemhauser, and Claire O'Sullivan will be leaving for London where she's hoping to put her OR skills to work while gaining OE! Best of luck to all of them.

Also a warm welcome to all of our new students, including Debbie Williams who's working with Andy Philpott on capacity expansion problems in telecommunications, and David Neilsen who will be working with Andrew Mason and Steve Butt on a rostering GRIF with Mantrack Decision Group Ltd.

Massey University News

John Giffin, Department of Mathematics, Massey University, Palmerston North, NZ
e-mail: j.w.giffin@massey.ac.nz

Kelvin H. Watson has completed and successfully defended his PhD, "Graph Theoretic Facilty Layout Design and Evaluation : Theoretical and Practical Considerations", supervised by John Giffin (who else?!). Kelvin completed his work in only slightly over two years – a record for Massey OR graduates (Kelvin is the fourth so far, with four more currently in the wings). His work investigated the design of new and improved techniques for the rectangular dualisation phase of Layout Design. The efficacy of the approaches was tested using concepts of regularity (as a surrogate for useability) and the incorporation of material handling systems to quantify transportation cost in test layouts. A three phase decomposition framework was also developed, whereby a decisionmaker could perturb problem constraints in a guided manner to generate a scenario of solutions which could be ranked using multiple criteria.

The thesis concluded that there is still life in the old GTLP yet – it can still comppete favourably with more classical Layout Design methods, and the construction of block plans has now been streamlined and given a stronger theoretical basis.

Kelvin is currently employed by James Hardy Pipelines in Palmerston North, where he is actually using his OR skills!

Smaller items from the windy city – Wellington

Kerri Mayes, Telecom, Wellington
e-mail: kerry.mayes@telecom.co.nz.

New arrival among the teaching staff in the Management Group at VUW is Dr Michelle Baron. Michelle has just completed her PhD at Stanford. Her speciality and PhD topic is Risk Management

Among the 7 ORSNZ members at IFORS were Vicky Mabin and John Davies. Apparently there was some excellent (and well attended) talks in the (new to IFORS) areas of 'Teaching OR/MS' and 'Teaching using Cases'.

Hugh Barr, Matthew Hobbs, and Tom Nicolle have stepped out of Industrial Research Ltd and have formed Infosmart Ltd to continue their consulting work. Infosmart provides business analysis, modelling and strategy principally to government agencies and primary processing / export companies.

Any of you Wellington people who think of something to go in this section, please let me know.

APORS'97 UPDATE:
The Fourth Conference of the Association of Asian-Pacific Operational Research Societies

Vicky Mabin, School of Business Administration, Victoria University, P.O.Box 600, Wellington
e-mail: Vicky.Mabin@vuw.ac.nz

As you may remember, the fourth APORS conference will be held next year at the World Congress Centre in Melbourne: the dates have been confirmed as 30 November to 4 December 1997. Planning for the conference is going well, according to Steve Weal, President of the Australian Society for Operations Research (ASOR), who spoke at the APORS committee meeting, held during the IFORS conference in Vancouver in July. Steve is coming to our local ORSNZ conference in August, so many of you will have the chance to meet Steve and talk to him about the conference.

ASOR is organising the conference, in close liaison with ORSNZ, and is keen to have as many New Zealanders as possible contributing to the conference. It will be a great opportunity for New Zealand OR people to exchange ideas with colleagues from Australia and all parts of Asia, the fastest growing region of the world, as well as participants from many other countries.

Now is the time to send off abstracts and ideas for tutorials, sessions or session streams, and offer any other suggestions for the technical or social programmes. Talk to Steve about the possibilities, or contact the program committee:

Technical Program Committee
Co-Chairs: Santosh Kumar and Moshe Sniedovich
APORS '97 Technical Program Committee
PR Conference Consultants Pty Ltd
PO Box 326, Balwyn 3103 Australia
Phone: +61 3 9816 9111 Fax: +61 3 9816 9287
e-mail: apors97@sci.monash.edu.au
URL: http://www.maths.mu.oz.au/~worms/apors/apors.html
ORSNZ representative: Vicky Mabin
Victoria University of Wellington, PO Box 600 Wellington
Phone: 04 495 5140 Fax: 04 495 5253
email: vicky.mabin@vuw.ac.nz

Remember this conference will replace our own ORSNZ conference for next year. The deadline for submission of abstracts is 28 February 1997. Submission forms can be obtained from Vicky Mabin or on-line from the web site.

INTRODUCING NZ'S FIRST MASTERS DEGREE IN DECISION SCIENCES

Dr Bob Cavana, Faculty of Commerce & Administration, Victoria University of Wellington, Wellington, NZ

In 1997, a new Master of Management Studies (MMS) degree in Decision Sciences will be offered jointly by the Management Group in the Faculty of Commerce and Administration and the Institute of Statistics and Operations Research at Victoria University of Wellington. The programme will emphasise modern developments in the decision sciences, incorporating linkages between 'soft' operational research, systems approaches and traditional operational research. It will provide mathematically oriented students with the concepts, techniques and knowledge required to analyse complex managerial problems and to improve managerial decision making processes in organisations in commerce, business and government.

The MMS(DecSci) divides into two parts, spread over four trimesters – full-time students can therefore complete the degree in sixteen months. Part 1 consists of four management papers and four decision science papers; and Part 2 consists of a thesis, or a research project and four further papers. The four management papers cover general organisation processes, including the way organisations behave and how managers make decisions and plan strategies for the future. Also a course in research methods is provided which will allow students to prepare their research proposal for the Part 2 thesis or research project.

Decision sciences courses cover a range of topics, including decision theory, problem structuring methods, policy modelling, operations research applications, simulation and stochastic

models, technical and environmental risk management, quality management, statistical methods, management information systems and social psychology.

The research for a thesis or research project could explore a theoretical or practical organisational issue by defining its problems, confronting them with the appropriate research methods, then communicating the results with clarity and precision. Where appropriate, mentors from client organisations may be arranged for students.

For further details please contact the programme director: Dr Bob Cavana, Management Group, Faculty of Commerce & Administration, Victoria University of Wellington, PO Box 600, Wellington, New Zealand (Tel +64-4-495 5137; Fax +64-4-495 5253; or E-mail: bob.cavana@vuw.ac.nz).

REPORT ON JULY ORSNZ COUNCIL MEETING

Mikael Ronnqvist, Department of Engineering Science, University of Auckland, Auckland
e-mail: m.ronnqvist@auckland.ac.nz
(Edited by Editor)

Council decisions and discussions

- The Society managed to reopen the old Wellington post-box and is now running this together with the Auckland box.
- The president reported that the OR group at Industrial Research Ldt has broken up. Bruce Benseman and Hugh Barr have started OR consulting businesses.
- Air New Zealand will sponsor the Young Practitioner's Prize 1996 with $1200.
- Mikael Ronnqvist will attend the IFORS96 conference as the ORSNZ representative.
- John Buchanan of Waikato University has been appointed as the new IFORS representative, replacing Hugh Barr.
- The President has been in contact with S. Kumar, the current President of APORS, and discussed making APJOR optional for all ORSNZ members. The Secretary is to hand over a time table for this process to S. Kumar at the IFORS96 conference.
- Dr Steve Butt has agreed to manage the membership database and was co-opted to Council.
- The lack of membership support for the OR Newsletter was discussed. Some ideas floated were:
  - Deadlines for copy to be disseminated to all Branches and Council members, and publicised in Newsletter.
  - A 'Branch News' section like NZMS Newsletter – a 'no news' entry for a branch/institution will be publicly excoriated (Webster: *'remove part of the skin, scathingly censure'* – Have your pick! *The Editor*).
  - Gossip columns from branches.
  - Abstracts and timetables for year 4 projects, Masters projects, and PhD projects.
  - Royal Society contributions.
  - Republished articles with permission form JORS Newsletter and others.
- The OR Society in the UK advertise a number of short courses for practitioners, which are essentially training tutorials in some field that has widespread application. Example titles are: 'Data Analysis and Database Design', 'Risk Analysis', 'System Dynamics Modelling', 'Business Planning Models using Spreadsheets', 'How to be an OR Consultant'. NZIM do something similar for managers, with titles like 'Negotiation skills' and 'Logistics Management', which are typically taught by practitioners, not academics.

Council members were all positive about such courses, but concluded that the Society should not invent and run them. Instead they should be initiated by members who may seek endorsement from the Society.

- Overseas invited speaker policy: Following on a suggestion by Vicky Mabin, there was a discussion whether ORSNZ should provide a contribution to the expenses of getting international experts to visit NZ as invited speakers. Recently George Nemhauser was paid $500 by the Society, and all agreed that his visit was great value for money. It was agreed that the ORSNZ should take more advantage of academic and OR practitioners visiting particular institutions in NZ, and offer financial support to enable them to visit all the ORSNZ Branches. Council agreed that the Society should build up a fund for invited speakers to travel within New Zealand to visit Branches. Grants in aid will be disbursed from this fund on a case-by-case basis to be decided by Council upon receiving an application from the visitor or host.

Items to be put on the AGM:

- The membership rate is $45. Council agreed that is was not desirable to increase this, except to keep in step with the annual CPI, so as maintain the same level of service to members. Council proposes to make such adjustments every two years and that the membership fee for 1997 be adjusted to $47.50.
- The cost of postage of material to overseas members has risen considerably. In line with other OR societies, Council proposes that overseas members be charged for the increased postage.
- A retired member suggested that the society should have a Retired Membership category with a reduced membership rate. Council proposes that the Society introduce an Associate Membership category with a fee equal to the student fee. The only service an associate member will get is the Newsletter. To become an associate member there is a requirement that the member should have been a full member of he Society for the last ten years and that the member is retired.
- The issue of membership fees for recently graduated students was raised. Council proposes that the Society allow graduating students to keep their student membership status during the financial year in which they graduate.
- ORSNZ conference locations: There is currently no specific schedule of the locations of the annual conference. Council propose the following cyclical schedule for the ORSNZ Conference location: Auckland (1998), Victoria/Massey (1999), Waikato (2000), Canterbury (2001), Auckland (2002).

MEETINGS CALENDAR

2ND INTERNATIONAL SYMPOSIUM ON OR AND ITS APPLICATIONS (ISORA'96)
11-13 December 1996
Guilim, China (sponsored by APORC)
Call for papers: (no deadline given) five copies of extended abstract on any major topics of OR, incl. real applications.
Programme Committee Chair: Prof. Ding-Zhu Du, Computer Science Dept. University of Minnesota, Minneapolis, MN 55455, USA
FAX: 001 612 625 0572; e-mail: *dzd@cs.umn.edu*

INTERNATIONAL CONFERENCE ON OPERATIONS AND QUANTITATIVE MANAGEMENT
5-8 January 1997
Jaipur, India
General chair: Omprakash K. Gupta, Indiana University Northwest,
3400 Broadway, Gary IN 46408-1197, USA
FAX: 001 219 980 6579; e-mail: *ogupta@ucs.indiana.edu*

THE INTERNATIONAL INSTITUTE FOR GENERAL SYSTEMS STUDIES
9 - 11 Jan. 1997
Southwest Texas State University, San Marcos, Texas USA
Main speakers: George J. Klir, Tuncer Oren, Lofti A. Zadeh
Call for papers: Two copies of abstracts of at least 800 words plus a one page summary by 10 June 1996. For more details contact
Dr Yonghao Ma, Co-chair
Dept. of Math., Southwest Texas State University, San Marco, TX 78666 USA
e-mail: *ma@iigss.math.swt.edu*

INFORMS San Diego Spring 1997 Meeting
4 - 7 May 1997
Town and Country Hotel, San Diego CA
General Chair: Fred Raafat, San Diego State University, College of Bus. Adm.
San Diego, CA 92182

9TH INFORMS APPLIED PROBABILITY SECTION CONFERENCE
30 June to 2 July 1997
Cambridge Mariott Hotel, Cambridge, MA
For more information e-mail: *ap97@bu.edu*

INFORMS Barcelona 1997 International Meeting
7 - 10 July 1997
Barcelona, Spain
Call for papers: title and abstract of no more than 100 words, incl.keywords, plus paper fee of US $75 by 30/11/96
Organizing Chair: Jaime Barcelo, Navarro Reverter 33, Barcelona 08017, Spain
e-mail: *BARCELO@EIO.UPC.ES*

5th INT. CONFERENCE OF THE UNITED KINGDOM SYSTEM SOCIETY
7 - 11 July 1997
De Montfort University and The Open University, Milton Keynes
Theme: Systems for sustainability: people, organisations, and environments
Call for papers: Abstract of max. 300 words by 31/7/96 (sorry! Try for a late entry!)
For more details e-mail: *uksconf@dmu.ac.uk*
or Prof. Ray Ison: *r.l.ison@open.ac.uk*

PORTLAND INT. CONF. ON MANAGEMENT OF ENGINEERING TECHNOLOGY
27 - 31 July 1997
Portland State University, Oregon
Call for papers: Title and 50 word abstract with keywords by 31 August 1996
For more details, see *http://www.emp.pdx.edu*
or e-mail: *picmet@emp.pdx.edu*

APORS' 97 - 4th Conference - PRELIMINARY ANNOUNCEMENT
30 Nov. 1997 - 4 Dec. 1997
Melbourne, Australia
Invitation to be added to mailing list, contact: APORS' 97, c/o ASOR Melbourne Chapter
GPO Box 1048H, Melbourne, Australia 3001
e-mail: *P.Lochert@sci.monash.edu.au*
FAX (61) 3 903 2227
If you intend to give a paper or organize a session, contact P. Lochert

INFORMS/CORS Montreal Spring 1998 Meeting
26 - 29 April 1998
Queen Elizabeth Bonaventura Hilton, Montreal, Canada
General Chair: Paul Mireault, Ecole des Hautes Études Commerciales,
5255 Avenue Decelles, Montreal, Quebec
e-mail: *Paul.Mireault@HEC.CA*

IFORS'99 Beijing
If you want to be on the mailing list e-mail: *ifors99@amath11.amt.ac.cn*
(Note 11 is eleven)