

## 30th ISMOR

### Ronnie Shephard Memorial Address

#### Professor Lyn Thomas

I am honoured to be asked to give the Ronnie Shephard Memorial Address particularly at this the 30th conference since he started the series when the Advisory Panel of Operational Research at NATO felt unable to support an international conference. I understand that the theme of this conference is reflecting on the changes in those thirty years and looking forward to the future. This is what my memorial address will also focus on. This is very relevant since it is also 30 years since the most influential time in my OR career when I was able to take a sabbatical year as a NRC Research Fellow at the naval Postgraduate School at Monterey. What a place to work. Then, and probably still today, it had the largest OR department in the US in immaculate grounds with its own Grecian style swimming pool. The scenery was perfect, with 19 Mile Dive and its golf course; Carmel beach with its white sand; wonderful weather except for the summer fog which made Mark Twain write the coldest winter I ever spent was a summer in San Francisco. While there I learnt from David Shrady who gave this address two years ago of Ronnie's very successful visit to that institution a few months earlier.

If you read Ronnie's papers on the internet you are amazed by the range and quantity of his published work - until you realise there were in fact two Professor Ronald Shephards working in Operations Research at that time – one in the Royal Military College of Science at Shrivenham and the other at Berkeley.

You need to be very careful if you look up your own name on the net. Go on we all have done it. If you type in Lyn Thomas you find as well as a Professor of OR at Southampton, a 1940s actress who started in some very questionable B movies. Even if you put in Professor Lyn Thomas you can be directed to someone who although they also went to Oxford now edits the Feminist Review and writes paper on lost and leisured femininities in contemporary lifestyle television,

When I was invited to give this talk I was somewhat inhibited that the calibre of the audience would mean there was no allowance for levity. So I was delighted to find that day a piece in the newspaper about what was the most intellectual joke you knew. The winner was the following

A Roman walks into a bar holds up two fingers and says Five beers please.

Followed closely by

An Englishman, a Frenchman, a Spaniard and a German were walking down a street. They find a juggler performing but there are so many people they cannot see the juggler. So the

juggler climbs up a platform and asks “Can you see me now”, The four men answer Yes, Oui, Si Ja.

To return to the theme of what I see as are the changes in OR and particularly military OR in the past thirty years. The first obviously is the change in the environment and so in the types of problems that need addressing. The ending of the cold war and the increased threat from terrorism leads to asymmetric problems. The fact that the military are increasingly involved in peace keeping roles means the old blue versus red models now involve blues, reds and pinks who may turn a darker shade. Economic factors have meant that cost as much as effectiveness has become the objective.

There has been far less development in solution techniques, The triumvirate of linear programming, dynamic programming and simulation continue to be the bed rock of most OR courses. Yet these were all developed at least 50 years ago. Increasingly models can be built and solved within Excel using at most the nonlinear optimiser in Solver. There have been newer heuristic methods developed or imported from data mining such as neural nets and genetic algorithms. But these concentrate on specific problems like shortest path or classification based decisions like those in credit scoring. Game theory has become a ubiquitous technique appearing not just in conflict modelling and search and rendezvous problems but also in multi agent supply chains and purchasing via auctions and network interdiction.

That brings us on to the main development of the last thirty years – the growth of the internet and the huge expansion in data availability. Now we are in the age of “Big Data” where the first indication to a health authority of an incipient epidemic is the rise in Google searches for what are its symptoms. The objective when dealing with such a mass of data is to get the correct information to the relevant decision maker in a timely, useful and protected manner. All those requirements lead to new and important OR problems. As to its use in OR I think it is essential to start with the problem and then see what relevant data is available rather than acquiring the data first and then thinking of what it is useful for.

Turning to developments in OR education, while at the Naval Postgraduate School I was very impressed with the real projects which led to the thesis which was part of their degree. Similarly as an external examiner at Shrivenham, (now part of Cranfield University) I was similarly impressed by the projects there. They were smaller in number but longer in duration, Sometimes though it is common sense and a way of explaining the result diplomatically which matter. I recall a NPS project on whether one could improve the current policy for replacing the aviation fuel tanks on aircraft carriers. This replaced half of them in every five year major maintenance fit. The biggest gain was got from the recommendation to keep a note of which ones had been replaced in the last fit!

As an academic experience which puts what has been learnt into perspective and teaches things like the relationship with the client it is a vital element of any course. Thus When I

introduced a new M.Sc. in Edinburgh University I made sure that industrial projects were a vital component. When I moved to Southampton I knew that their M.Sc. had a long history of projects with particularly strong links with Dstl and DERA before that. We have continued to build on that and have for several years have employed two industrial liaison officers whose job it is to find and develop these outside projects in conjunction with the companies. I am pleased to say that almost all the UK M.Sc. courses have such projects and the income from them helps with the funding of EU nationals on OR courses.

The practicality found in these projects contradicts that old adage about the difference between an engineer, an OR analyst and a mathematician. An engineer thinks his equations are an approximation to reality. An OR analyst thinks that reality is an approximation to his equations, While a mathematician doesn't care provided the equations are pretty.

And so to the future. The first thing to say is do not introduce OR into your home life despite Ralph Keeney's excellent plenary talk on using OR to improve the quality of your life" at the Seattle INFORMS conference . I was inspired by this and so on watching me wife make the breakfast and walking back and for to the fridge I mentioned that this seems a good problem to optimise using one of the logistic algorithms. The result was a sort of triumph for OR. Instead of it taking my wife 20 minutes to make breakfast now it take me 15.

I will only touch briefly on the likely developments in military OR since you are the experts and this is what this conference is all about. I would then like to make some comments on the future of the OR Societies , OR publications and OR education. Returning to this conference I am sure you will not experience here what happened in the first conference I attended nearly 40 years ago. This was held in Dublin and one lunch time the conference was taken around the Guinness brewery there. At the end one was invited to compare the different products and then we returned for the afternoon talks. After about 5 minutes the first speaker of the afternoon asked would any one object if he sat down. About 5 minutes later his head sank onto his chest and he went fast asleep. The half of the audience who were awake quietly got up and left leaving the rest to their slumbers It is the only time I have seen someone go to sleep in their own lecture, though falling asleep in others lectures is an occupational hazard.

As an outsider it seems to me there are new OR problems at many different levels in the military arena.. At the strategic level there are multi-party cross borders conflicts that will need new tools just as the Rand corporation did for cold war negotiations. At the tactical level the limitations in manpower and specialised resources will become more important constraints in the models to be developed. There will also be new applications of existing OR problems. We recently developed a model for the replacement and recalibration , that is the repair of a classification system and I was surprised how sparse was the literature on replacement of data dependent classification and decision systems. Yet many of the future decisions will be made by automatic software systems which is data dependent. How frequently one will need to rebuild those systems as the data on which they are based

changes is going to be an important problem. Game theory will continue to play an increasingly important part in problems from logistics and supply chains to protection and congestion of networks both computer and physical. It has the advantages of coping with asymmetric conflict, but the disadvantage of assuming adversaries are rational. Game theory may also highlight the problem of individual optimality against social optimality. If the Tom Tom tells everyone the optimal way to avoid congestion then it will only increase the congestion. So it needs to lie to some users and tell them sub optimal routes. But to whom, how often and will that break their trust. My wife has christened our Tom Tom "Nora" because she claims all I ever say is "Ignore her" .

On a more general level what is the future of the OR Societies, The numbers in the US Society continues to grow and those in Europe range from gentle growth to gentle decline, It would be good though if there were more interaction between the Societies. When I was President of the OR Society we introduced reciprocal arrangements for the prize speakers of the US and UK Societies to give talks at the conference of the other Society. I think in the spirit of the Ryder Cup we should restart that again at the European and American level. The debate about a name rather than OR will always be with us but I suspect that shortly we will have Analytics in the titles of some of the Societies It has the advantage that like economics it is in use by the general public even if they do not understand what it means. It also has the advantage of ensuring that areas like Marketing analytics and financial analytics will feel this is the Societies they have most connections with. Will Military Analytics follow in due course? As to the major conferences they will continue from strength to strength but mainly as ways of seeing where the subject in general is developing and making personal contact. The internet and Skype do not give the sort of relationship, a shared meal and discussion at a conference will give. Increasingly though the specialist conferences will thrive. ISMOR is an excellent example and must remain one of Ronnie Shephard's greatest contribution to OR. It is where the real research collaboration in an area takes place. I started a biennial conference in Edinburgh in the credit scoring area in 1989 and this year there will be 500 attendants ( two thirds from industry) from over 27 countries and it has generated many new ideas and collaborations. Such specialist conferences will be a feature of most OR areas in the future.

A more uncertain note is struck by the future of OR publications. Here there are two uncertainties. Firstly the advent of open access journals where the authors have to pay sometimes significant amounts to have their work published in a journal but then readers can access free of any charge. This is being pushed by the UK authorities with the idea that at the next but one assessment of academic research only such articles will be considered for the assessment. In Big science and medicine , the grant giving authorities are building in the extra publication costs into the grants they award, but for areas like OR where grants are much smaller in values this is not happening, So there will be a real financial penalty on

researchers for publishing their work. The other negative effect of these research assessment exercises, which started in the UK but are now found worldwide is the tendency to rate journals and not papers. Researchers need to contribute four papers to this exercise and because the assessment panel say in Management is around 12 to 14 and there are 16000 papers for them to examine there is the feeling they just go by the journal it is published. Even though someone like Mike Pidd who gave this lecture in a previous conference and is the chairman of the overall panel has said this is not the case, it is unfortunate that Deans of management and Mathematics Schools who only usually are expert in one area make promotion and hiring decisions on the basis of this. This problem affects OR more than most disciplines because there are only two OR journals that were put in the highest grade, compare to over 20 in other management areas. So what is happening is that OR researchers are submitting to those journals. Thus the editors of the highly rated journals are able to influence research to a considerable extent. Moreover journal editorship which used to be seen as a service to the subject is now seen as a career with an editor of one journal moving directly to edit another one. In order to get their journal a higher ranking some are quite explicit in their requirement that you cite a sufficient number of papers published in their journal. Finally there is the advent of on line journals with quicker turnaround times and easy access, So what is one paying for when one subscribes to a journal. Is it the referring process to ensure the quality and veracity of the articles. In that case what about comments on the paper or a rating. One can extend the idea of Trip Advisor to Research paper Advisor. Maybe each paper should have a Twitter account with followers who are interested in it. I do not know how it will develop but it is a real matter of concern. In my early days you went to the library to look at a paper in the journal and so often the paper that took your interest was the one next to it. Now sitting at a desk and googling it you tend only to go to that paper or maybe the ones which cite it. Much more efficient but something of the holistic view of the subject is lost on the way.

Lastly let me turn to the future for OR education. As I said I am relaxed if in 30 years' time we will be talking about business analytics or Operational Research or some hybrid. What is important is what is being taught and how it is being taught. We want students and researchers to be able to solve problems. It is the problem first and foremost and the data and solution techniques come second and third. I agree we need to teach the techniques but more importantly how to understand and formulate the problem. That includes understanding the culture, constraints and psychology of the organisation and in the case of game theory based models, the culture and constraints of the other organisations, . There are undergraduate OR programmes but I believe that the non-mathematical skills and possible experience means OR is more effectively taught at the postgraduate level. Such programmes would work very well as part time adjuncts to a job in analytics or what happened to two of my Ph.D. students after several years in the OR environment. However it is clear in the UK if not in other countries yet that the steep rise in undergraduate tuition fees make students less willing to undertake a postgraduate degree. The shadow of the

debt no matter how deferred it is means students want to get into employment to start paying off the debt. Thus there may need to be more flexible arrangement between the organisations with groups of young OR analysts and the educational institutions that can support their development. I think some of the interactions between OR education and OR users in the military could be copied in other industries with benefits for all.

Let me finish on a personal experience despite my warning. When he was 15 my elder son did a psychological and aptitude assessment at school which was the first step to get him thinking about career choice. You know the sort of think if you are good with numbers and lack the personality to be an accountant then how about being an actuary. My son's assessment came back saying he was bright, logical, liked problem solving, slightly introverted and willing to make decisions. I was delighted that the first choice it suggested was as an OR analyst, mainly because it meant OR was on the data base of professions. In fact he has ended up as a consultant in intensive care in a hospital. But when I ask him what he does he tells me it is dynamic programming. There is an overall objective to maximise the chance of a patient surviving their stay in the unit; .a number of different procedure or treatments that have an immediate affect but also change the state of the patient so that the clinician knows that the will need to administer another treatment after an interval. So if unfortunately you will have to be in Intensive Care Unit realise that it is operational research and not just the operation that is saving you.

Thank you