Newsletter

Operations Research Society of South Africa
Operasionele Navorsingsvereniging van Suid-Afrika

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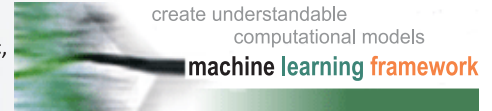
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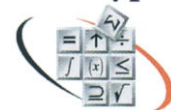
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FROM THE EDITOR

Contactable at: 14556561@sun.ac.za

Danie Lötter

Greetings to all the ORSSA members. Welcome to the final issue of 2011. This edition kicks off with the letter from the president, Dave Evans, who is stepping down as president in 2012. This is followed by an article on a joint chapter event between the Johannesburg and Pretoria chapters in conjunction with SAIIE. A very interesting article within the realm of Graph Theory, entitled *From the Roman Empire to Secure Domination,* features in this edition. The member interview is conducted with the outgoing president of the society. This edition also includes a book review by Hans Ittmann.
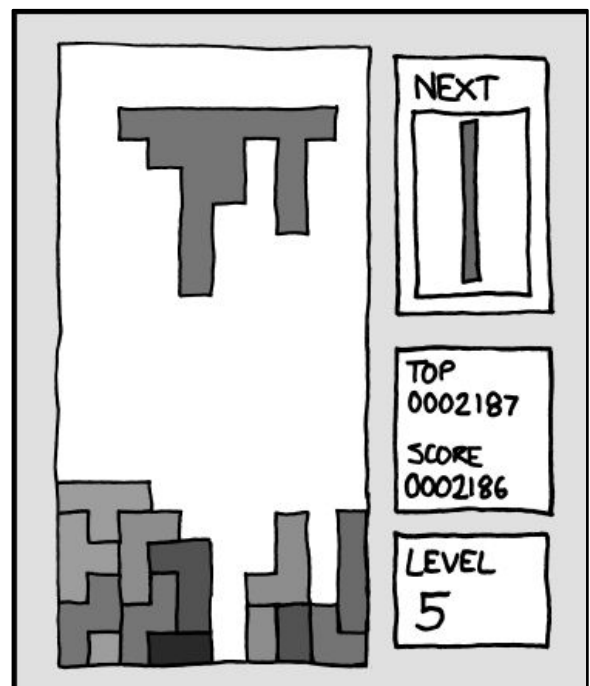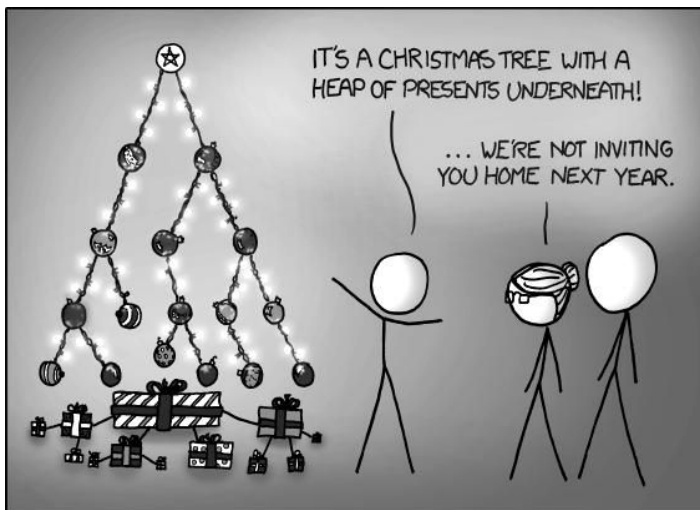
After a two-year term, I have decided to step down as editor of the Newsletter. However, I was appointed as Business Manager of the Newsletter for 2012. Mark Einhorn is the new Newsletter editor and will commence his duties in January 2012. Congratulations to him. I wish him all the best in his new role. I would also like to congratulate the rest of the 2012 Executive Committee on their election and wish them good luck in their various portfolios. Thank you for giving me the opportunity to be part of such a great organisation. Enjoy the festive season and have a great holiday. ☺

Features

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FROM THE PRESIDENT'S DESK

by Dave Evans (davee@dbsa.org)
ORSSA President

And so I come to my last 'From the President's Desk' contribution. Two years have flown by, as they always do these days, and I step down in three weeks' time, although you will obviously not be reading this today.

A society such as ours has several roles to play; those around looking after the interests of members obviously have to be conducted at a level which satisfies what you, the members expect from us, and a major duty of the National Executive Committee is to ensure that we meet those demands. Whilst I will be handing over to Jan van Vuuren, the structure of the presidential portfolio is such that I will still be on the Exco as vice-president in 2012, and I invite all members who have any comments or ideas to contact me (or, I'm sure, Jan, although I haven't got his permission to put those words in his mouth. ☺) I am particularly interested in any additional things you think the Society should be doing for you.

One area I hope to be able to give more attention to, once I've handed over the reins to Jan, is marketing. As we've said on many occasions before, the profile of people who enjoy OR is quite a bit different from that of sales and marketing types. I feel we are doing ORSSA a disservice by 'hiding our lamp under a bushel', as we have done for most of the forty years I've been around the Society; this is a topic we've discussed on several previous occasions over the years.

Perhaps more to the point, I believe strongly that this is also doing the country a disservice, and I'm now climbing back onto an old hobby horse of mine which you will have heard me on before – I make no apologies. The gap between what South Africa is, and what it can be, and needs to be, is substantial. The opportunities and needs in the public sector are enormous, and the potential for OR to help is significant, and well defined and understood, as demonstrated by countless papers in OR journals around the world over the past fifty years at least. You,

our members, are publishing papers on similar issues and presenting at our conferences regularly these days. I personally am really appreciative of that; please keep it up. Several of the papers at the conference at Victoria Falls addressed similar subject areas in Zimbabwe, which is equally encouraging.

I have to confess to a personal disappointment, however; the higher one can get into public sector organisations with our ideas, the wider impact we can potentially make. Whilst I've been sounding like a stuck record on the theme for a while now, I've been relatively unsuccessful to date in achieving that. I also know from several colleagues in the Society who have tried similar interventions that it is difficult. Having said that, however, I'm still trying. Should anyone have contacts which we can pursue, or be involved in projects where ORSSA supports will help, please don't hesitate to pull us in.

To close, I'd like to thank you all for the involvement and support you've given me and the Society during my tenure as President. I also have to mention the social interactions at the various events we arrange, which continue to be as enjoyable and memorable as they were thirty years ago. To the various office bearers in our teams; national, chapters, conference and publications organising, etc., huge thanks for the significant amounts of time you give to ORSSA; we couldn't be what we are without you. This is all done for free, in people's spare time, and unless you've been responsible for those portfolios, you've no idea how much work is involved, and how big a debt the Society owes to them all. To Jan: I wish you all the success which I know you will have as President. Having worked closely with you for several years now, I know that I could not be entrusting the future leadership of the Society to a safer pair of hands.

And finally, whilst you haven't quite seen the back of me yet, all the best for the future to ORSSA and you, the members.

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JOHANNESBURG AND PRETORIA JOINT CHAPTER EVENT

by Dave Evans (davee@dbsa.org)

As many of you will be well aware, there is a significant overlap between Industrial Engineering and OR. ORSSA has had various interactions with SAIIE – the South African Institute of Industrial Engineers – over the years. Our past-president, Marthi Harmse, led a team which organised a very successful joint conference in Vanderbijlpark in 2005. However, these interactions have typically been on a 'once off' basis.

The Pretoria Chapter of ORSSA and Carien Botha of the SAIEE have recently established a special interest group of SAIIE on OR, and the first meeting was held at the Development Bank of Southern Africa in Midrand on 24th November. It was jointly hosted by the SAIEE and the Pretoria and Johannesburg Chapters of ORSSA. Some forty five people attended a set of presentations by four members of OPSI, a consulting company, on their use of OR in Logistics. Their name comes from OPtimisation and SImulation; a very OR source for a company name.

Several case studies were presented on aspects such as the travelling salesman problem: they used a 'travelling housewife' as an example, progressively complicating her day to demonstrate how the realities of life confuse the solution of what could otherwise be superficially simple problems. A real life, nation-wide, example was also described, to demonstrate how somewhat artificial, but non-the-less very real constraints from the client made sub-optimal solutions the best that could be achieved.

A simulation study was also described on the practicalities of designing an off-loading yard and bays for a new factory, which had very variable frequencies of deliveries of different raw materials. The model could demonstrate the impacts of proposed approaches, and various 'what ifs' prompted by the outcomes. This allowed the client to develop a substantially different and more effective solution from the one originally envisaged.

The evening closed with informal networking over snacks sponsored by OPSI, and drinks sponsored by ORSSA.

It was a most successful event, and given the commonality between SAIIE and ORSSA mentioned above, we look forward to similar events in the future. Thanks to OPSI for the presentations, and Elias Willemse for MC-ing the evening, and for leading ORSSA's contribution to setting it up.

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http://www.or2012.de/welcome.html?&no_cache=1

From the Roman Empire to Secure Graph Domination

by Alewyn Burger, Anton de Villiers and Jan van Vuuren
Department of Logistics, Stellenbosch University

The Roman Empire

During the third century A.D., Roman emperor Constantine the Great (272 – 337) faced the problem of efficiently deploying the twenty five legions of Roman soldiers at his disposal in order to protect the Roman empire. A grouping of six legions, called a *field army*, was deemed sufficient to secure any one of the eight regions of the empire shown in Figure 1. The Emperor thus had four field armies at his disposal. These eight regions of the empire may be modelled by means of a graph, called the *empire graph*, denoted by E (superimposed on the map in Figure 1), whose vertices denote the regions of the empire and in which two vertices are joined by an edge if the corresponding regions are adjacent. The emperor decreed that two field armies be stationed in a region before one would be allowed to move to an unoccupied, neighbouring region in an attempt to ensure that any uprising in the region vacated by the moving field army could successfully be quelled.
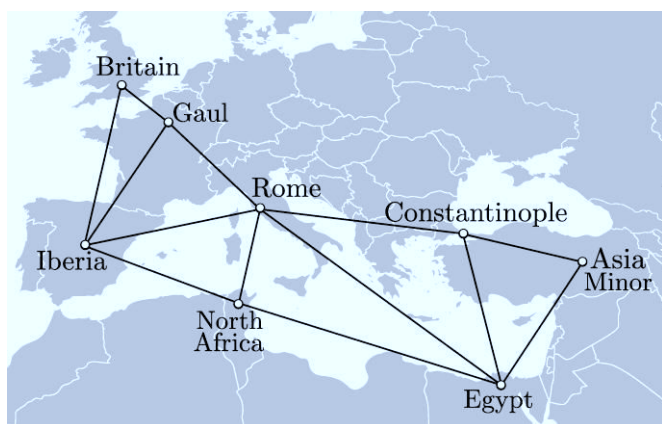

Figure 1: The various regions of the Roman empire during the 3rd and 4th centuries A.D.

A deployment of field armies would therefore secure the entire empire if every region was either occupied by a field army, or if it was directly adjacent to a region that was occupied by two field armies. Emperor Constantine therefore had to answer the following two questions:

- What is the minimum number of field armies required to secure the empire?

- If the available number is less than this minimum, how should the field armies be stationed in order to secure the largest number of regions of the empire?

Domination and Roman domination of a graph

A subset of the vertex set of a graph G is said to form a so-called **dominating set** of G if every vertex of G is either a member of the subset or adjacent to a member of the subset. Furthermore, the **domination number** of G, denoted by $\gamma(\mathrm{G})$, is the size of a smallest dominating set of G. In order to secure the entire Roman empire, Emperor Constantine therefore at the very least required a dominating set of the empire graph E in Figure 2 when seeking a deployment of his field armies. An example of a dominating set is shown in Figure 3 for the graph E. However, a dominating set of minimum size is shown in Figure 4 for the graph E. It would therefore, at first glance, seem that the emperor had a sufficient number of field armies at his disposal to secure the entire empire against uprisings.
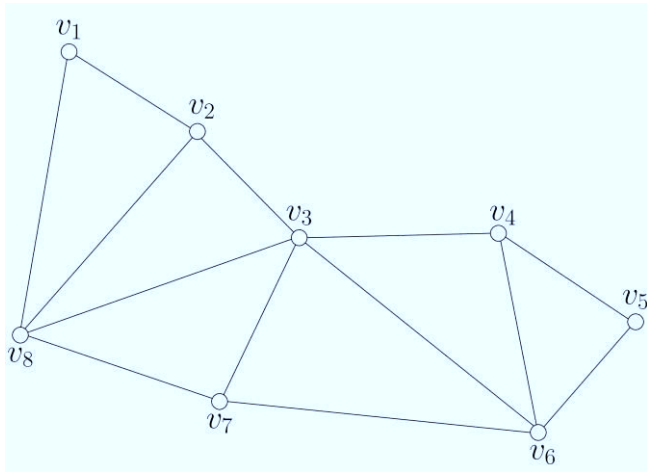
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Figure 2: The graph E **used to model the geographic area of the Roman empire during the 3rd and 4th century A.D. The various regions are:** $v_1 \equiv$ **Britain,** $v_2 \equiv$ **Gaul,** $v_3 \equiv$ **Rome,** $v_4 \equiv$ **Constantinople,** $v_5 \equiv$ **Asia Minor,** $v_6 \equiv$ **Egypt,** $v_7 \equiv$ **North Africa and** $v_8 \equiv$ **Iberia.**
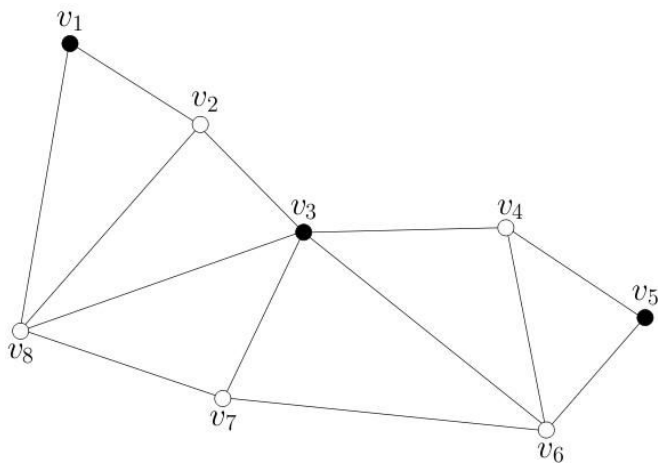

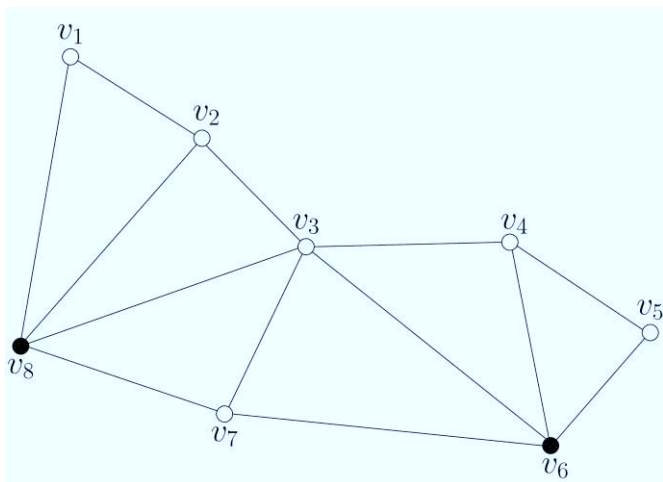**Figure 3: An example of a dominating set for the empire graph** E **in Figure 2.**

Figure 4: An example of a minimum size dominating set for the empire graph E **in Figure 2.**

The additional requirement in the emperor's decree that two field armies should be stationed in a region before one of them would be allowed to move away, however, placed an additional burden in terms of field armies required to secure the empire over and above the domination number, $\gamma(E) = 2$. A distribution of field armies over the vertex set of a graph G is said to form a **Roman dominating set** of G if every vertex of G either has at least one field army stationed at it or is adjacent to a vertex with two field armies stationed at it. Furthermore, the **Roman domination number** of G, denoted by $\gamma_R(G)$, is the size of a smallest Roman dominating set of G. It is known that

$$\gamma(G) \leq \gamma_R(G) \leq 2\gamma(G)$$

for any graph G. An example of a Roman dominating set of (minimum) size $\gamma_R(E) = 4$ is shown in Figure 5 for the empire graph E. This Roman dominating set shows that the emperor could have placed two field armies in Rome (v_3), one in Britain (v_1) and one in Asia Minor (v_5), thereby securing the entire empire according to his military requirements. It is a mystery why the emperor, perhaps for political reasons, decided to place two field armies in Rome and two in his newly founded capital Constantinople instead, as shown in Figure 6. The emperor's deployment of his field armies left Britain undefended against uprisings; it is therefore no wonder that by 410 A.D. the empire had lost Britain altogether.

Secure domination of a graph

Emperor Constantine was clearly concerned about *simultaneous* or *coordinated* uprisings challenging Roman authority. However, if it is assumed that no such coordination was possible, and hence that no two vertices of the empire graph E could experience simultaneous uprisings, then fewer than four field armies would have sufficed to secure all the regions of the empire. In this case the appropriate graph theoretic model involves the notion of secure domination instead of Roman domination. A **secure dominating set** of a graph G is a dominating set of G with the additional property that it should be possible to perform a swap between any vertex not in the set with some vertex in the set, yielding as the resulting configuration another dominating set of G.
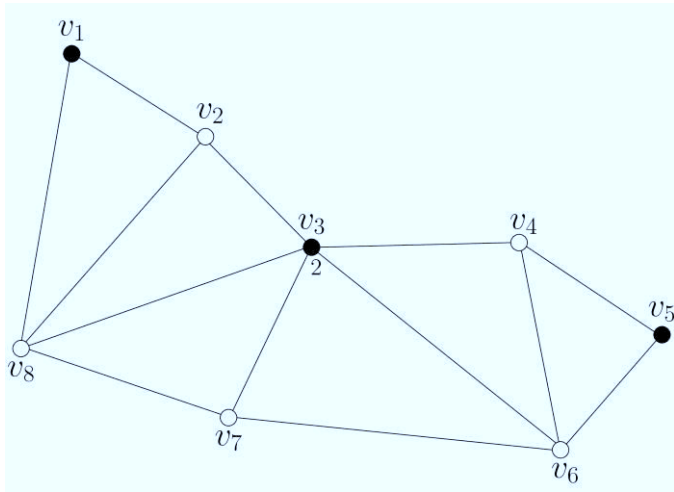
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Figure 5: An example of a minimum size Roman dominating set for the empire graph E **in Figure 2.**
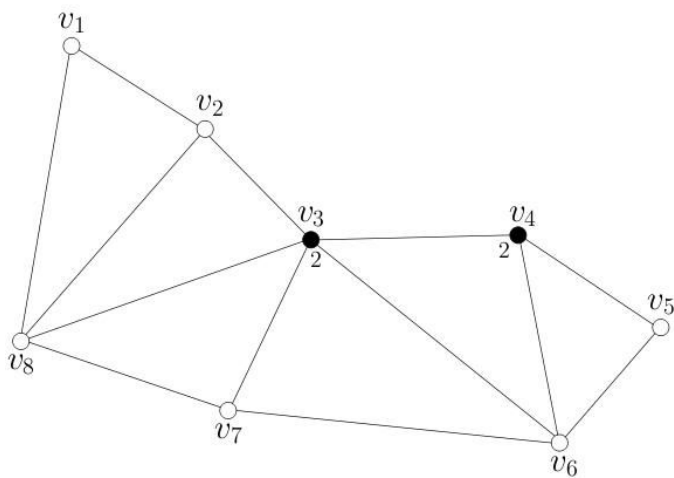

Figure 6: The deployment strategy of field armies decided upon by Emperor Constantine.

Figure 7: An example of a dominating set of the empire graph E **, which is not a secure dominating set, with an uprising at node** v_3 **dealt with by moving the field army at node** v_6 **to node** v_3 **.**

Furthermore, the **secure domination number** of G, denoted by $\gamma_s(\mathrm{G})$, is the size of a smallest secure dominating set of G. Although the deployment of field armies shown in Figure 4 – one in Iberia (v_8) and one in Egypt (v_6) – is a dominating set for the empire graph E, it is not a secure dominating set. To see this, suppose an uprising were to occur in Rome itself (v_3). Then the field army in Egypt (v_6) would not be able to move to Rome to quell the uprising (as shown in Figure 7), for that would leave Asia Minor (v_5) insecure or undominated (as shown in Figure 8). The field army in Iberia (v_8) would similarly not be able to move to Rome to quell the uprising (as shown in Figure 9), for that would leave Britain (v_1) insecure or undominated (as shown in Figure 10). In fact, $\gamma_s(\mathrm{E}) = 3$, and a secure dominating set of this size is shown in Figure 10, representing the posting of a single field army in each of Gaul (v_2), Rome (v_3) and Constantinople (v_4).

Modern applications and edge failures

A more modern application of Roman domination may be found in the naval strategy of the British empire. Until the mid-19th century, Britain possessed a sufficiently strong naval force to deploy its so-called *battle fleets*, consisting of approximately 20 ships, over key regions of interest across the entire globe shown in Figure 12. Due to the weakening power of Britain, the change to steam propulsion and the greater maritime power of Germany, the British had to revise their strategy towards the end of the 19th century. By 1900 Britain only had four battle fleets even though modernisation allowed for fewer ships to constitute a battle fleet. A problem not too dissimilar to Emperor Constantine's protection of the Roman Empire presented itself to the British Lord of the Admiralty: Two battle fleets were required to occupy a region before one could move to another region. Admiral Lord John Fisher decided to place three battle fleets in Britain and the remaining fleet in the Mediterranean. Only three of the six regions of interest were Roman dominated by this placement of the battle fleets, while Revelle and Rosing (2000) identified thirteen different Roman dominating sets (each consisting of four battle fleets) for securing the entire globe.

Figure 8: Moving a field army from node v_6 to deal with an uprising at node v_3 leaves node v_5 insecure.
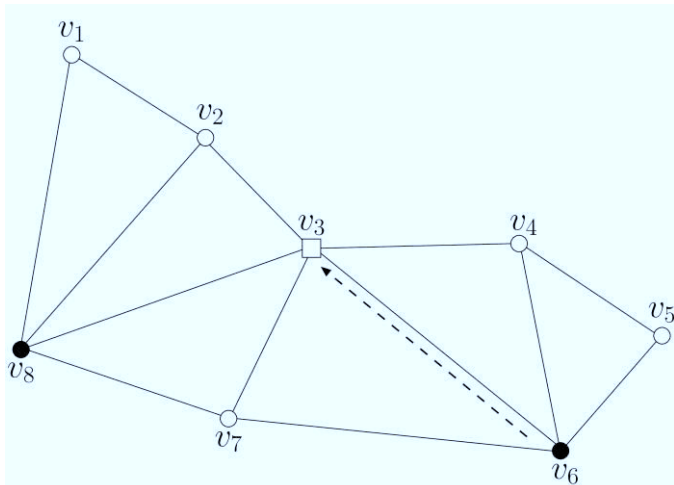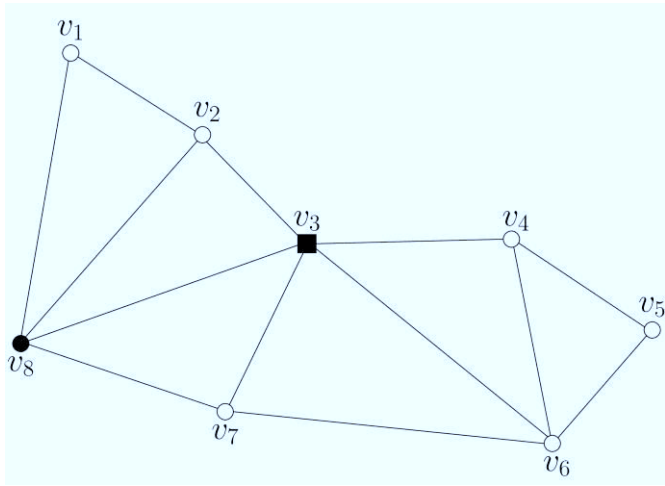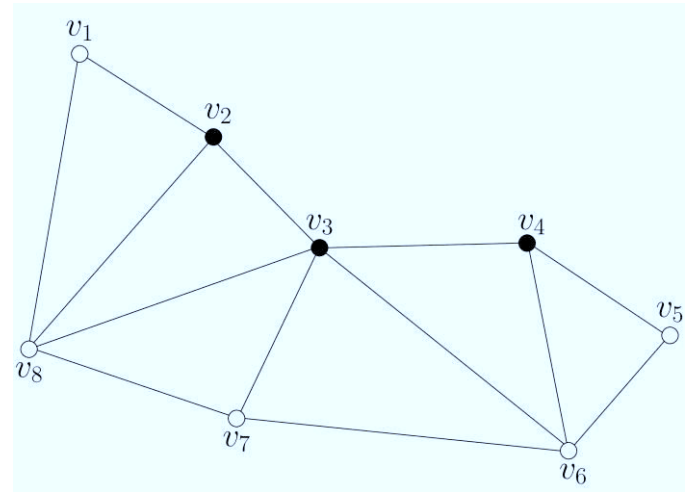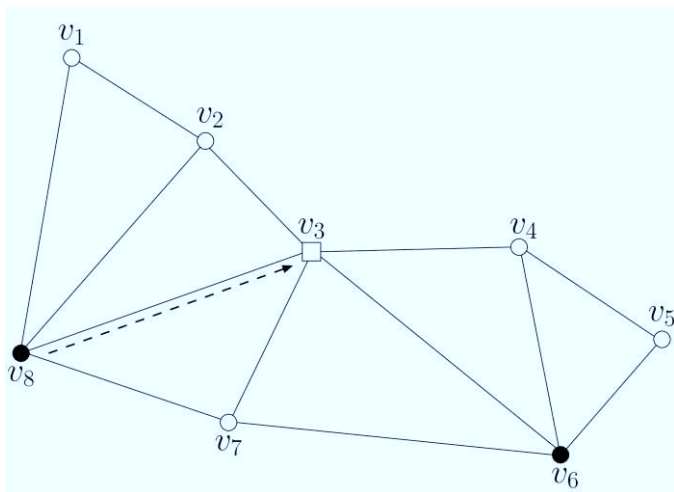

Figure 9: An example of a dominating set of the empire graph E, which is not a secure dominating set, with an uprising at node v_3 dealt with by moving the field army from node v_8 to node v_3.
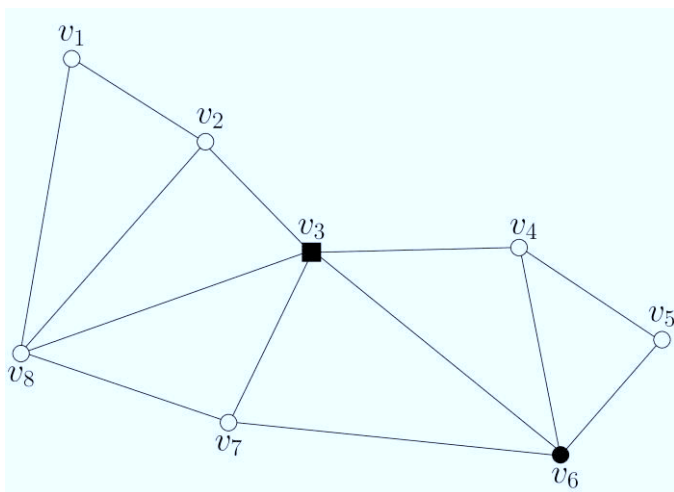

Figure 10: Moving a field army from node v_6 to deal with an uprising at node v_3, leaves node v_1 insecure.

Figure 11: An example of a minimum size secure dominating set for the empire graph E in Figure 2.

Secure domination in graphs also has more modern applications, such as in the security industry, where the graph may represent a surveilance system or patrol system in which the vertices are the surveillance components or security guards and the edges represent lines of sight or patrol access routes between various components.
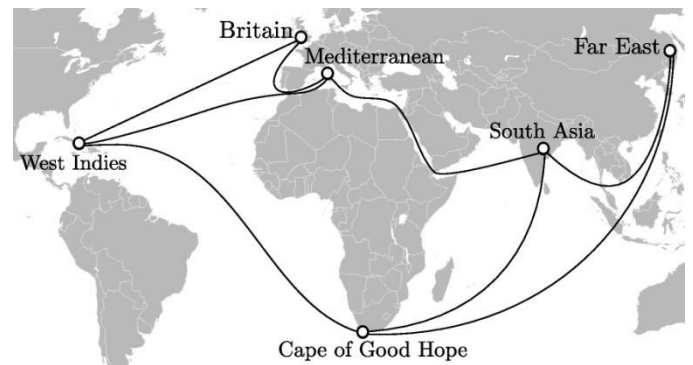
Figure 12: The regions of interest and their accessibility to the British navy around 1900.

In applications of secure domination the notion of edge failure is important, because one might seek the cost (in terms of the additional number of field armies, security guards or surveillance components required to protect a system in, say, the secure dominating sense) over and above the original minimum number if a number of edges of the graph were to fail.

Edge sensitivity and edge criticality

Given a graph with m edges, the notation $G - qe$ is used to denote the set of all non-isomorphic graphs obtained by removing $0 < q \leq m$ edges from G. Furthermore, $\gamma_s(G - qe)$ denotes the set of values of

Figure 13: A branch-and-bound tree containing all non-isomorphic graphs in the sets $K_4 - qe$ **for** $0 \leq q \leq 6$.

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$\gamma_s(H)$ as $H \in G - qe$ varies (for a fixed value of q). The cost functions

$$c_q(G) = \min\{\gamma_s(G - qe)\} - \gamma_s(G)$$

and

$$C_q(G) = \max\{\gamma_s(G - qe)\} - \gamma_s(G)$$

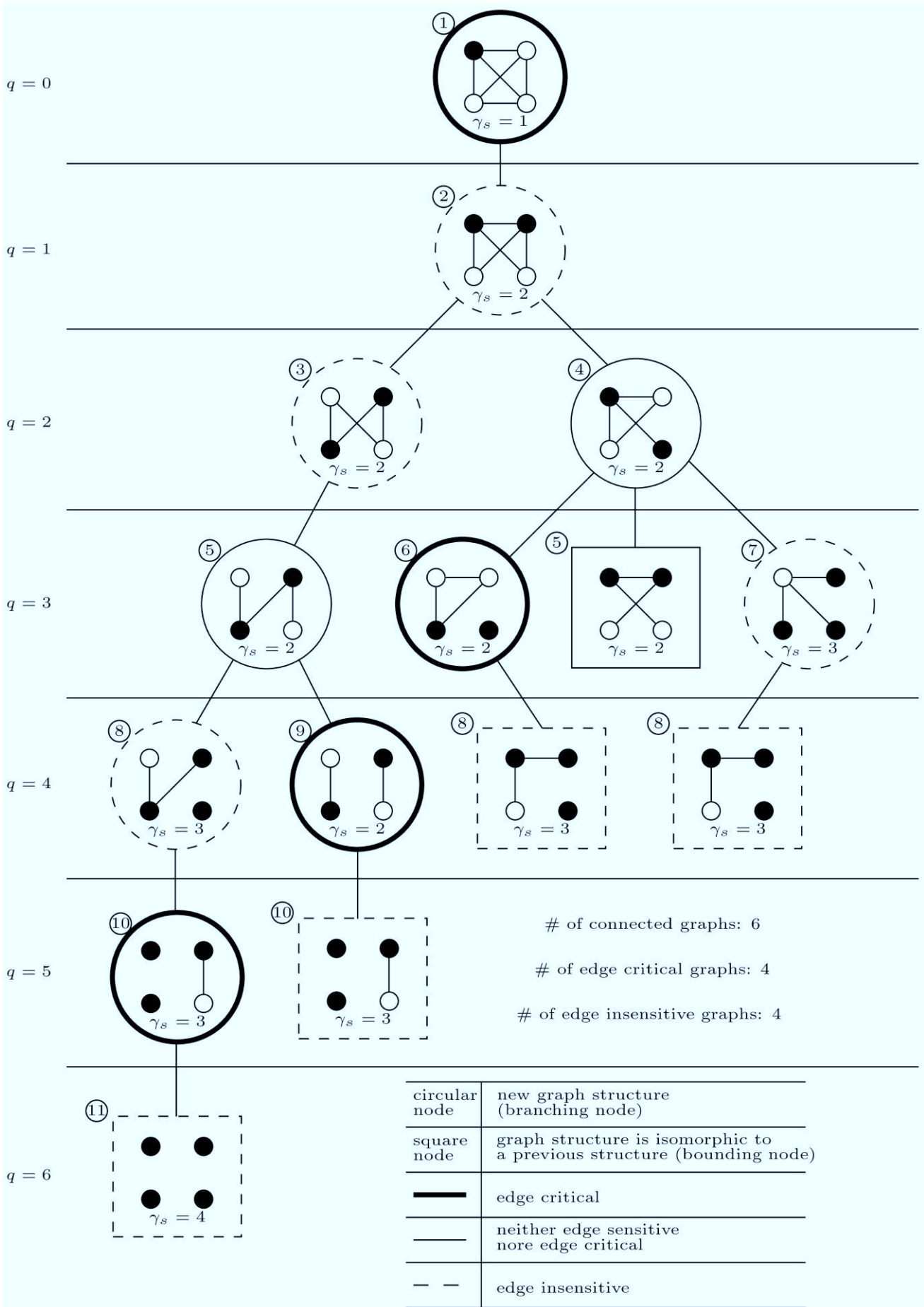are non-negative and measure respectively the *smallest possible* and the *largest possible* increase in the minimum number of field armies, security guards or surveilance components required to dominate a member of $G - qe$ securely, over and above the minimum number of guards originally required to dominate G securely, in the event that an arbitrary set of $0 < q \le m$ edges are removed from G.

A graph G is said to be *edge q-critical* with respect to secure domination if $c_q(G) > 0$. Similarly, a graph G is said to be *edge q-sensitive* with respect to secure domination if $C_q(G) > 0$.

Note that a graph which is edge q-critical, is also edge q-sensitive, but that the converse is not necessarily true. A path graph P_n of order n is a graph consisting of a single path. The cost functions $c_q(P_n)$ and $C_q(P_n)$ are evaluated in Table 1 for the path P_6 of order 6 for all $0 < q \le 6$. These results may be verified by means of the result by Cockayne *et al.* (2005) that $\gamma_s(P_n) = \lceil 3n/7 \rceil$. It is clear from the table, that the path P_6 is, for example, edge 2-sensitive, but not edge 2-critical.

Current work at Stellenbosch University

To the best knowledge of the authors no previous work has been done to date on secure graph domination in terms of additional guard costs when edges fail or are removed. A definitive and useful research output will certainly be the construction of repositories for the minimum and maximum additional number of guards required when removing a certain number of edges from a member of a special graph class, such as the class of paths, cycles, trees, *etc.*

A branch-and-bound approach may be used to construct a tree-like data structure from which q-critical and q-sensitive graphs may be identified. Such a data structure is shown in Figure 13, using a complete graph of order 4 as the root of the tree. By removing any edge from the graph labelled 1, the graph labelled 2 is obtained, which requires an additional guard or field army, and so forth. The tree contains four edge critical graphs, labelled 3, 6, 9 and 10. Also, four edge insensitive graphs may be found in the tree: those labelled 2, 3, 7 and 8. For example, consider the graph labelled 2: removing any of its edges does not increase the number of guards or field armies required to securely dominate the resulting graph. Since this branch-and-bound tree grows very rapidly as the number of vertices of the root graph increases, various tree pruning strategies should be used to identify isomorphic graphs for a specific value of n and q, thereby reducing the size of the search tree. For example, the graph labelled 5 is formed in two different branches, but is only considered in the first branch. Similarly for the graph labelled 8.

q	$\mathcal{P}_6 - qe$	γ_s	$c_q(\mathcal{P}_6)$	$C_q(\mathcal{P}_6)$	A graphical representation
0	$\mathcal{P}_6$	3	0	0	
1	$\mathcal{P}_1 \cup \mathcal{P}_5$	4	0	1	
	$\mathcal{P}_2 \cup \mathcal{P}_4$	3			
	$2\mathcal{P}_3$	4			
2	$2\mathcal{P}_1 \cup \mathcal{P}_4$	4	0	1	
	$\mathcal{P}_1 \cup \mathcal{P}_2 \cup \mathcal{P}_3$	4			
	$3\mathcal{P}_2$	3			
3	$3\mathcal{P}_1 \cup \mathcal{P}_3$	5	1	2	
	$2\mathcal{P}_1 \cup 2\mathcal{P}_2$	4			
4	$4\mathcal{P}_1 \cup \mathcal{P}_2$	5	2	2	
5	$6\mathcal{P}_1$	6	3	3	

Table 1: The costs $c_q(P_6)$ and $C_q(P_6)$ for $0 \le q \le 5$, where P_6 denotes a path of order 6. Secure dominating sets are denoted by solid vertices.

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A natural extension of this approach may be to determine the cost functions $c_q(P_n)$ and $C_q(P_n)$ for a number of simple classes of graphs G analytically, including paths, cycles, trees, circulant graphs, grid graphs, complete multipartite graphs and complete graphs.

Further reading

[1] Burger AP, Cockayne EJ, Grundlingh WR, Mynhardt CM, Van Vuuren JH & Winterbach W, 2004, Finite order domination in graphs, Journal of Combinatorial Mathematics and Combinatorial Computing, **49**, pp. 159-175.

[2] Cockayne EJ, Grobler PJP, Grundlingh WR, Munganga J & Van Vuuren JH, 2005, Protection of a graph, Utilitas Mathematica, **67**, pp. 19-32.

[3] Revelle CS & Rosing KE, 2000, Defendens imperium romanum: A classical problem in military strategy, The American Mathematical Monthly, **107(7)**, pp. 585-594.

[4] Stewart I, 1999, Defending the roman empire!, Scientific American, December, pp. 136-138.

EURO 2012 25th European Conference on Operational Research 8-11 July 2012

Vilnius, Lithuania, 8-11 July, 2012
SECOND ANNOUNCEMENT AND CALL FOR PAPERS

We invite all researchers, academicians, practitioners, as well as students interested in any branch of operational research, mathematical modelling or economic analysis to participate at the Conference and to present their papers.

We are convinced that the EURO XXV Conference will be an excellent opportunity for the OR community to get together again in a pleasant atmosphere, and, thus, we are looking forward to meeting you in Vilnius, the historical capital of Lithuania, in 2012!

Please visit the EURO XXV Conference website on

www.euro-2012.lt

INFORMS INTERNATIONAL Beijing 2012

In conjunction with the Operational Research Society and
Tsinghua University
June 24-27, 2012
China National Convention Center
Beijing, China

The 2012 INFORMS International Conference is scheduled for June 24-27, 2012 in Beijing, China. On behalf of the Organizing and Program Committees, I invite you to attend this international meeting. The conference will be hosted by Tsinghua University and will take place at the National Convention Center in the Beijing Olympic Park. A wide range of accommodation is available around the Park, from budget accommodation up to seven-star hotels.

The theme of the conference will be **OR/MS for a Sustainable World**. The role of OR/MS in the delivery of social, environmental and economic benefits is increasing in importance but also presents unique challenges and opportunities. The 2012 INFORMS International Conference will be a showcase of relevant research that addresses these challenges and opportunities in the OR/MS context. It will also provide an opportunity for networking for all participants.

Beijing, as the capital of China with over 5,000 years' history, has numerous historic and scenic spots, such as the Great Wall, the Forbidden City, the Summer Palace, and the Temple of Heaven. Moreover, Beijing has undergone many changes in recent years and is becoming a thoroughly modern and cosmopolitan city. The 2012 INFORMS International Conference will provide you with a memorable opportunity to experience it. We can assure you that the distinctive beauty of Beijing and its incomparably warm hospitality will contribute to making your stay not only fruitful, but also most enjoyable.

Please visit the following website for more information:

http://meetings2.informs.org/beijing2012//

2012
41st ORSSA Annual Conference

16-19 September 2012

An advance warm welcome to the 41st Annual Conference of the *Operations Research Society of South Africa* (ORSSA)! The Conference will be hosted by the Pretoria Chapter of ORSSA, supported by the Johannesburg Chapter, and will be held at the Aloe Ridge Resort, north west of Johannesburg, from September 16th to 19th, 2012.

The conference will open with a welcome reception on Sunday evening September 16th and will close at lunchtime on Wednesday September 19th. Participation over the full spectrum of Operations Research is encouraged, including papers of a more fundamental nature, those on the application of Operations Research techniques in business and industry, about topical issues in Operations Research, and about the philosophy, teaching and marketing of Operations Research.

Delegates are responsible for their own travel and accommodation arrangements. The Aloe Ridge Hotel is recommended, as the Society has arranged *very* competitive rates for delegates. Travel directions to and reservation contact details of the Aloe Ridge Resort may be found by visiting the ORSSA website at the address below.

Conference delegates have the option either to present non-peer reviewed papers at the conference (as we have become accustomed to in the past, and for which only an abstract submission is required), or to submit full papers for peer-review with the intention of having their papers published in conference proceedings, if accepted for publication. Important dates:

14 March 2012	Early bird registration & abstract/paper submission opens
17 May 2012	Abstract submission closes for reviewed papers
24 May 2012	Notification of acceptance of abstracts of reviewed papers and go-ahead to submit full papers for peer-review
23 June 2012	Submission of full papers for inclusion in the conference proceedings closes
11 July 2012	Early bird registration closes
29 July 2012	Abstract submission closes for oral presentation of all papers
22 August 2012	Notification of abstract acceptance for non-reviewed papers
22 August 2012	Notification of acceptance of reviewed papers for proceedings

'Reviewed papers' above refers to full papers submitted for peer-review with a view to inclusion in the conference proceedings.

Please visit the conference website for information:

www.orssaconf.org.za,

then click on 2012 Conference

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MEMBER INTERVIEW: DAVE EVANS

Contactable at: davee@dbsa.org

Dave Evans

Our retiring president, Dave Evans, was born and raised in Yorkshire, which is fairly obvious from his accent; despite being in southern Africa for forty years, it is still very pronounced, although he says it gets even worse when he is back there visiting family.

He attended university in England, at Cambridge and Imperial College, London, obtaining an MA in Biochemistry and an MSc in Operational Research and Management Studies, which he describes as 'an MBA with all the OR options, in modern terminology.' He has been in this part of the world for over forty years now, and recently celebrated his 65th birthday.

He met his wife of 37 years, Lindsay (Mells, at the time) in AECI's OR Group. They were doing very similar work, using linear programming and simulation to help plan AECI's fertilisers and chlor-alkalis and plastics businesses.. They have twin sons who live in the United States. One is an assistant professor at the Worcester Polytechnic Institute, just outside Boston, running their Gas Turbine Research Lab, and is married with two children. The other is doing OR on a post-doctoral fellowship with NASA in San Francisco, exploring policy decisions on the future of the civil aviation industry, and is recently married. Both attended Wits University, won post graduate scholarships to MIT in Boston, and have since received PhDs in aeronautical engineering from Cambridge.

Dave's other interests include aviation (he helps out at the SAAF Museum at Swartkop), sports (he still plays squash) and reading. He is also an external examiner in OR and advisory committee member in the Wits Engineering Faculty.

How and when did you first become involve in OR?

It was almost an accident. I had always leaned towards maths, despite my first degree ending up as biochemistry, and I was sitting in the reception of the careers guidance office at Cambridge, waiting for an interview, with no idea of what I wanted to do next. I stumbled over OR in a booklet. My first reaction was 'What?', as it was a phrase I'd never even seen before. Fortunately I had time to read it, and went into the interview with a completely new idea of where I was going. The MSc at Imperial College was the next and first step down that road.

When did you become a member of ORSSA, and what led to your decision to become a member?

I had some interactions with ORSSA when I came out from the UK to join AECI, as AECI was a corporate member in those days, but I only joined in my personal capacity in 1979, after five years with AECI in Zimbabwe. I wanted to get more involved than I had been up to that point.

What have been your most memorable OR events in your OR career?

My first OR job, for ICI in England, was building a simulation model of the metabolism of a dog, for heart drugs research. Obviously my biochemistry degree came in handy there. That was fascinating.

My early OR days with AECI were fascinating, seeing how much impact OR can make when given the chance. I particularly enjoyed a long range planning project on the future of the AECI/mining industry explosives contract where, with hindsight, the first thing I had to do was build a very primitive equivalent of Excel, in Fortran, before we started evaluating business options. The project team of about eight people stretched from main board executives down young techies like me; great fun.

Being made a fellow of ORSSA in 2007 was also very significant for me, as well as being very humbling, that the Society felt I deserved that honour.

As I say when I give general talks on OR, certainly for me, one of the huge pluses of just doing OR is that it is also great fun, building models, trying out all the 'what

ifs', interacting with people, helping to get better decisions made.

How did OR affect your career?

I have always done my OR in the private sector, although I've done a fair bit of guest lecturing at universities, to give students experience of real live case study examples. OR in business gives one the opportunity to see almost all aspects of how an organisation works, so if you do decide you want to spread your wings a bit, firstly you know where you want to go and what you will be letting yourself in for, and secondly, you've been able to demonstrate your capabilities to your potential new boss. For me, it acted as a springboard into all kinds of things; strategic management, logistics, organisational development, IT management, risk management and factory administration. What more opportunity could you ask for?

What does your current work entail? Do you think your OR experience contributed to you getting where you are today?

Without a doubt, OR put me onto the track I've followed ever since, as I have indicated. OR trains one in a mindset which is very valuable for almost any job. Question assumptions, understand the problem properly, look at all the options, understand the politics, try and get common metrics for comparisons, don't be too proud to use any tools: statistics, economics, change management, etc., in addition to our own OR set; those are all approaches which are applicable practically anywhere.

You have been ORSSA president for the past two years. Can you tell us more about your experiences over the past two year in your role as ORSSA president?

Running any organisation where the office bearers are all volunteers has a common set of characteristics. They are in those posts because they want to contribute, and in the case of our Society, they are also very competent professional people. The President's role is therefore more about helping to identify the direction required and leading and steering the team, rather than managing people in the classical sense. We also have a situation where this wonderful information technology which seems to get bigger/faster/better every year (am

I sounding like an advert for a bank?) also means that we all seem to be even more overloaded every year than we were last year. That means I also have a role to encourage everyone to find the time to look after ORSSA, in amongst their frantic other demands.

I've been lucky to have several great recent role models; I'd particularly like to single out Hans Ittmann who, in addition to being our president recently, also headed the Local Organising Committee for the very successful IFORS Conference we hosted in 2008; as one of his team members, I was able to see an expert in action and pick up very valuable tips.

It's also a thoroughly enjoyable and privileged position to have been entrusted and honoured with; I got to meet all kinds of fun and interesting people, and watch the development of, and interact with, all the new operations researchers coming up through the kind of experiences that I was having forty and more years ago.

Do you have any advice for people who want to make a career in OR?

If you want an academic career in OR in South Africa, things are relatively straightforward. Do a degree with OR as your major, and that will introduce you to that world.

If you want a career in the private sector, the entry is the same, but the way forward is a lot more difficult these days than it was forty years ago. 'OR Groups' in business, which used to be the natural way in, are few and far between in the classical sense. Sasol has an excellent one, which wins international awards, and the CSIR has had a group for many years working in that area. Many other private sector entities, such as the big banks, employ people who do OR, although that label is rarely used these days. And those central OR Groups that companies like AECI, Caltex and the big mining houses used to have, have largely disappeared. There are also specialist consulting companies like OPSI (referred to in an article of this edition), and the consulting companies such as Deloitte do OR, even if they don't call it that. Industrial Engineering overlaps enormously with OR, so an aspiring operations researcher could also do a lot worse than apply for industrial engineering jobs. If I ever do get a government OR Group set up, I'll let you know.

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Tales and Vignettes from
Profiles in Operations Research

by Hans Ittmann (hittmann@csir.co.za)
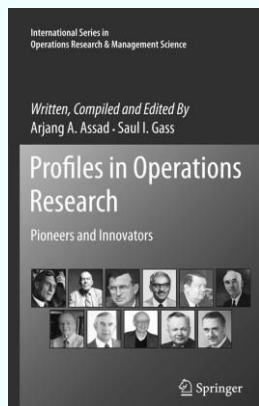
It was a pleasure to read a recently published book on the history of Operations Research (OR) titled ***Profiles in Operations Research – Pioneers and Innovators***. The book was written, compiled and edited by Arjang Assad and Saul Gass and is a follow-up to their earlier book titled: ***An Annotated Timeline of Operations Research: An Informal History***. In ***Profiles*** the objective was to describe and capture the history of OR through the lives and contributions of eminent OR pioneers and innovators. The authors selected those they thought contributed significantly to the field of OR from its military origins some 70 years ago. In the end the work of some 43 personalities are recounted in this volume of 867 pages. In essence it contains short biographies of these pioneers with the main focus on their technical contributions and work while there is also more personal information and some interesting stories about, or from, these individuals. Some of these are captured here to wet the appetite of potential readers of this wonderful addition to the ever growing literature on the history of OR.

A nice story on Patrick Blackett, of Blackett Circus fame, during World War II: "...he (Blackett) came one morning, deep in thought, into the G (technical) Office of Stanmore. It was a bitterly cold day, and the staff were shivering in a garret warmed over only with an oil-stove. Without a word of greeting, Blackett stepped silently up on to the table and stood there pondering with his feet among the plans. After ten minutes somebody coughed uneasily and said, diffidently: "Wouldn't you like a chair, sir.... or something?' 'No, thank you', said Professor Blackett, 'it is necessary to apply scientific methods. Hot air rises. The warmest spot in this room, therefore, will be near the ceiling". At this, Colonel Krohn, my technical G.S.O. stepped up on the table beside the Professor, and for the next half-hour, the two stayed there in silence. At the end of this period Professor Blackett stepped down from the table saying: 'Well! That's that problem solved.' And so it was". (Pile 1949, 161 and Profiles 2011, 7)

The Elephant in the Book: Oskar Morgenstern (1976, 811), in his paper, "The collaboration between Oskar Morgenstern and John von Neumann on the theory of games" noted: "We wrote virtually everything together and in the manuscript there are sometimes long passages written by one or the other and also passages in which the handwriting changes two or three times on the same page. We spent most afternoons together, consuming quantities of coffee, and Klari (von Neumann's wife) was often rather distressed by our perpetual collaboration and incessant conversations. She was at that time collecting elephants made of ivory, glass, and all sorts of material. At one point she teased us by saying that she would have nothing more to do with the ominous book, which grew larger and consumed more and more of our time, if it didn't also have an elephant in it. So we promised we would happily put an elephant in the book: anyone who opens the pages can find a diagram showing an elephant if he knows that he should look for one." The elephant appears in on page 64 of the *Theory of Games and Economic Behavior* (von Neumann and Morgenstern 1944) in the guise of a discussion of partitioning elements of a set. (Profiles 2011, 72)

Charles Goodeve, well known British OR personality from the early years of OR, was the originator of the following: This is believed to be the first organization [IFORS] to have a square root in its Constitution: it was Charles' idea that the individual societies should contribute financially in proportion to their membership, but have voting powers proportional to the square roots of their memberships. (Profiles 2011, 92)

West Churchman made some comments on ethics: "I think one reason a professor discourages the discussion of ethical issues among his students in class is that he

himself has no satisfactory answers; as a person, he made hold strong ethical beliefs, but he cannot 'objectively' profess them since his intellect recognizes that they are all subject to doubt. What he fails to realize is that ethics is not a body of theory substantiated by facts. Instead, it is (a?) process of continuously – and I think eternally – discussing and debating and occasionally fighting over the issues. In short, ethics is a dialectical process in which all humanity, past, present, and future must take part". (Churchman 1979, 118 and Profiles 2011, 191)

Most OR people know that George Dantzig was the father of linear programming. There is another "urban legend" involving him: If you search the Web for "urban legend George Dantzig" you will probably find the first hit to be "Snopes.com, The Unsolvable Math Problem" (Snopes 2009). That website recounts the story of how George, coming in late for his statistics class, mistakenly thought two problems written on the board by Neyman were homework problems. After a few days of struggling, George turned his answers in. About 6 weeks later, early on a Sunday morning, he and Anne were awakened by someone banging on their front door. It was Neyman who said: "I have just written an introduction to one of your papers. Read it so I can send it out right away for publication" (Snopes 2009). George's answers to the homework problems were proofs of then two unsolved famous problems in statistics. Snopes (2009) and Albers et al. (1990, 67-68) give all the details about how George's experience ended up as a sermon for a Lutheran minister and the basis for an introductory scene in the 1997 Oscar-winning film "Good Will Hunting". The solution to the first homework problem is given in Dantzig (1940). The solution to the second problem became part of a joint paper with Abraham Wald who proved it in 1950, unaware that George had solved it until it was called to his attention by a journal referee. Wald just added George's name as co-author (Dantzig and Wald 1951). Neyman had George submit his solution to the homework-problems as his doctoral dissertation. (Profiles 2011, 220)

Very few people know that Russell (Russ) Ackoff was trained as an architect and the following was his first architectural assignment: "I was in the invasion of the Philippines on the island of Leyte. After the occupation of the island was completed, General Selbert asked me (then a sergeant) to design and build a recreation center for the troops. I did that using only materials at hand, bamboo, grass (nipa, a long grass), trunks of palm trees, and abandoned signal corps wire. Labor was provided by natives whom I hired, both men and women. The center involved a long dock that extended out into the Barugo River to be used for swimming. The dock was a large cage for large abandoned empty oil drums, and therefore it could rise and fall with the tide. While installing the bridge, I was in the river in the nude when the general suddenly appeared in his motor launch. I jumped out of the water onto the dock and saluted him. He broke out into laughter and explained that he had never been saluted by a nude soldier before". (Ackoff 2009 and Profile 2011, 389)

Some wisdom from Russ Ackoff and Pat Rivett on the task of the OR worker: "It can be said with justification that his task is to advise executives and management but not to make the decision himself. The ultimate responsibility for the decisions still rests with the executive or manager. With this we agree, provided that certain conditions are met by the OR worker. First of all, he must feel fully committed to the decision to which he has come. He must be prepared, if invited to do so by the executive concerned, to say what decision he would undertake if he were sitting in the manager's chair....He must be willing to be judged by the manager in exactly the same way that the manager has to be judged, namely, on the basis of the performance of his recommendations when they are put into operation". (Rivett and Ackoff 1963, 98 and Profiles 2011, 392)

Richard (Dick) Bellman, the guy who played a huge role in dynamic programming, was quite a character: While his was a graduate student at Johns Hopkins University, Dick lived very cheaply in an apartment with two roommates. Their landlord had very strict rules that disallowed pets. This caused Dick to launch an involved practical joke. He bought a small turtle at a pet shop and begged the landlord that he be allowed to keep it. When this was agreed to, Dick went back to the pet shop each week and exchanged the current turtle for a larger one. After a while, the landlord was flabbergasted by the size of the turtle and insisted that it be removed. Dick pleaded again, promising that he could shrink the turtle back to a more acceptable size. The process for exchanging turtles was now reversed. The landlord could never understand how Dick

accomplished the shrinking. (K Bellman 2009 and Profiles 2011, 418)

A lesson in life is recounted by Ronald Howard who was very involved in decision analysis: "While I was studying for my master's degree in electrical engineering at MIT, I took all the coursework required to obtain a masters degree in industrial management as well. Most of the courses were offered in a building that Alfred P. Sloan had donated to house the School of Industrial Management. One day, Mr Sloan came to the campus to dedicate the building: thereafter, the school would be known as the Sloan School. As part of the ceremony, he gave a brief talk, the floor was opened for questions from the assembled students. As I remember it, one student asked a question whose answer had a profound effect on my life. The question was: 'Mr. Sloan, your success in business is an inspiration to us all. Was it worth it in terms of your personal life?' Mr. Sloan's reply was brief: 'No, my children are strangers. Next question'. At that point I resolved never to make financial or professional success the main goal of my life". (Howard 2008 and Profiles 2011, 779)

Finally the elements of good decision making are present in the chapter on Howard Raiffa and come from a book he jointly co-authored: "Address the right *decision problem*. Identify your real *objectives*. Develop a range of *creative alternatives*. Understand the *consequences* of the alternatives. Make appropriate *tradeoffs* among conflicting objectives. Deal sensibly with *uncertainty.* Account for your *risk-taking attitude*. Plan ahead for *linked decisions over time.*" (Hammond et al 1999 and Profiles 2011, 503)

There is much more in this book which captures the development of our discipline in an admirable way. A review of the book will be in the December 2011 edition of the IFORS newsletter.

QUERIES AND CONTRIBUTIONS

Any queries and contributions to the newsletter are most welcome, especially article submissions. For any queries and contributions, please contact the newsletter editor: Danie Lötter
Email: 14556561@sun.ac.za

DISCLAIMER

The views expressed in this newsletter are those of the contributors and not necessarily of the Operations Research Society of South Africa. The society takes no responsibility for the accuracy of details concerning conferences, advertisements, etc., appearing in this newsletter. Members should verify these aspects themselves if they wish to respond to them.

International Association of Engineers
International MultiConference of Engineers and Computer Scientists 2012

IAENG International Conference on Operations Research (ICOR'12)

Hong Kong, 14-16 March, 2012

The conference ICOR'12 is held under the International MultiConference of Engineers and Computer Scientists 2012. The IMECS 2012 is organized by the International Association of Engineers (IAENG), a non-profit international association for the engineers and the computer scientists. The IMECS conferences serve as good platforms for our members and the entire engineering community to meet with each other and to exchange ideas. Our IMECS committees have been formed with over three hundred conference committees members who are mainly research center heads, faculty deans, department heads, professors, and research scientists from over 30 countries. The last IMECS 2011 has attracted more than eight hundred participants from over 50 countries.

All submitted papers will be under peer review and accepted papers will be published in the conference proceeding. The abstracts will be indexed and available at major academic databases. The accepted papers will also be considered for publication in the special issues of the journal Engineering Letters, in IAENG journals and in edited books.

Please visit the following webpage for more information:

www.iaeng.org/IMECS2012/ICOR2012.html

HARNESSING THE POWER OF DATA TO OPTIMISE BUSINESS RESULTS

Francois Beyleveld, at SAS, explains why sustainability as a concept offers a watershed of opportunity for better business performance through innovation, while also benefiting the planet and employees' own careers.

Francois Beyleveld

More and more South African companies are beginning to realise that 'greening' their IT infrastructures brings greater business efficiency, return on investment and improved levels of service to their organisations.

In fact, organisational performance as we know it, demands sustainability measures across social, environmental and economic factors, which in turn requires the vital steps of integrating and analysing data to achieve new goals and transform internal organisational cultures. Technology companies in particular are at the forefront of green IT initiatives, because they acknowledge that their reputation as socially responsible entities is critical.

The right choices

By deploying the right technologies, IT can play a significant role in furthering a company's ability to monitor, analyse and implement more sustainable, or green practices, defined as those that meet the requirements of the present day without compromising the ability of future generations to meet their needs. In many cases, making small, incremental changes in IT processes can lead to definitive benefits.

When it comes down to the practicalities of doing business in an increasingly energy-hungry world, most companies are now looking at their supply chain and their ability to measure, monitor and improve their efficiency footprint within their organisations. Those that cannot demonstrate that value, might find themselves out in the cold when the next tender request comes around.

Another aspect that is becoming more important in green IT is employee retention and recruitment. Talented employees have many employment options and are increasingly looking at their employers and their stance on corporate responsibility and the environment. Clearly, reducing energy use is more about being environmentally responsible. To ensure their long-term viability, organisations must begin now to find and implement solutions that decrease power consumption.

The tools

The good news? Many of the same tools and practices that have enabled these organisations to reduce IT complexity, streamline operations and controls are also highly effective in energy use to help companies become lean, clean and green organisations. These include data de-duplication, high availability and virtualisation, power management and energy efficient data centre design.

The most strategic enterprises will use data, and the intelligence gained from it, to their competitive advantage – driving increased brand value through innovation and improving internal efficiencies and accountability. They will also build loyalty in consumers, employees and other stakeholders – such as in higher education where they track, communicate and educate on sustainability.

Today, companies are able to measure, manage and report on the Triple Bottom Line – environmental, social and economic indicators – and determine business strategies to reduce risk and increase shareholder value.

The results

Harnessing sophisticated software, companies are able to measure key sustainability activities using methodologies and protocols, utilising their existing data in operational systems and databases.

They are also able to report ongoing performance to ensure transparency with key stakeholders and compliance with regulatory agencies. By establishing an integrated, consistent source of quality information, companies can bind initiatives to a common sustainability framework that allows alignment across all lines of business – from water treatment facilities to the data centre,

Additionally, companies are able to improve performance by identifying metrics that have the greatest impact on goal attainment so that they can make the most informed strategic decisions by using optimisation, forecasting and data mining capabilities to analyse scenarios and run simulations to improve response and successful strategy execution.

Organisations can also manage and forecast the finances and resources needed to achieve the desired outcomes across the enterprise and within each department. Using analytics, they are able to prioritise organisational strategies and align investments in new product innovation, programme management and talent accordingly and establish scorecards and strategy maps driven by the sustainability goals of the organisation.

To end

In closing, going green offers a vital path to innovation and creating enduring value and competitive advantage. Despite the challenges of adopting an environmental mind-set, the direction that companies have to head in is clear, and it is clear that IT has a key role to play. When people start understanding the strategic risk and strategic opportunities of climate change in terms of its impact on brand value, their market and their operations, they'll get engaged in a much broader environmental agenda.

To learn more about how to meet the requirements for real-time decision making, contact SAS on +27 11 713 3400 (Johannesburg and Pretoria) or +27 21 912 2420 (Cape Town) or visit www.sas.com/sa

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