Newsletter

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

March 2012
www.orssa.org.za

FROM THE EDITOR

Contactable at: 14854937@sun.ac.za

Mark Einhorn

Hello to all ORSSA members and a warm welcome to the first edition of the newsletter for 2012. I trust that it will be a prosperous and fulfilling year for the society and its members. I would like to congratulate my predecessor Danie Lötter on an excellent job in delivering a fine newsletter over the past 2 years. I aim to maintain this high standard and intend to make each edition as interesting and enjoyable as in the past.

This edition begins with a word from the newly inaugurated president, Jan van Vuuren, and the introduction of the new Executive Committee. The feature article in this edition is entitled *The Potential of Self-Organisation in Traffic Control,* and is concerned with the fields of self-organisation and simulation modelling. The member interview is conducted with Anton de Villiers who is a PhD student in Operations Research at Stellenbosch University. The newsletter concludes with a thoroughly enjoyable book review by Hans Ittman, particularly if you are a sports fan. Before I sign off, I would like to point out two notices on page 3 regarding retired member fees and student CV advertorials. Cheers all and enjoy the read!

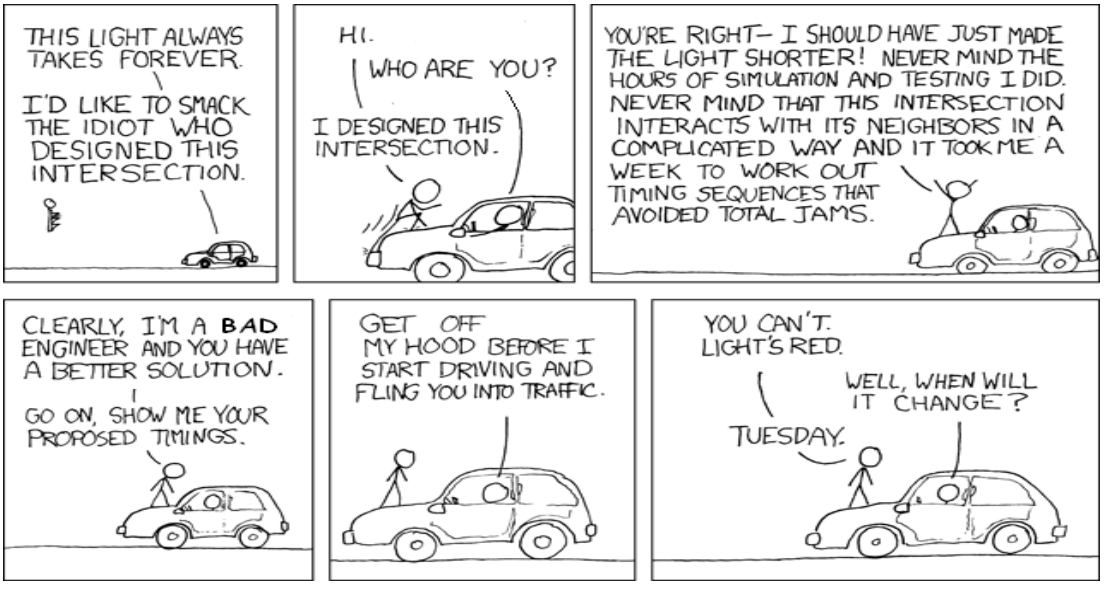
Features

	Page
FROM THE EDITOR	1
FROM THE PRESIDENT'S DESK	2
ORSSA EXECUTIVE COMMITTEE 2012	3
FEATURE ARTICLE: THE POTENTIAL OF SELF-ORGANISATION IN TRAFFIC CONTROL	4
MEMBER INTERVIEW: ANTON DE VILLIERS	8
BOOK REVIEW: DUCKWORTH LEWIS – THE METHOD AND THE MEN BEHIND IT	11

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: Mark Einhorn

Email: 14854937@sun.ac.za



www.xkcd.com

FROM THE PRESIDENT'S DESK

by Jan van Vuuren (vuuren@sun.ac.za)
ORSSA President

Jan van Vuuren

I would like to wish every ORSSA member and the Society as a whole the very best for the remainder of 2012, which started and has already advanced at an impressive pace. May this be a very precious, prosperous and productive year for all of us!

I would also like to thank you for the privilege of entrusting me with the responsibilities of President of our Society. It is a tremendous honour, and I would like to assure you that I shall be doing everything in my power to live up to the demands of the position.

My sincere thanks go to each member who served on the *Executive Committee* (EC) of 2011. Thank you for each manning your portfolio with dedication amidst other (significant!) pressures of work. Your sacrifice of valuable personal time to the benefit of the Society is much appreciated. I would particularly like to thank Dave Evans, our outgoing president (and fortunately returning Vice President), for his significant contribution as President over the past two years. He has set a high standard – indeed, a hard act to follow. Dave, I shall certainly lean on you for advice.

I extend a big and sincere thank you to all EC members of 2011 who have seen their way open to continue serving the Society this year. It is good to have so many experienced "old hands" on board. A very warm welcome also to our four new EC members: Tanya Lane-Visser (Secretary), Mark Einhorn (Newsletter Editor), Jason Matthews (Webmaster) and Elias Munapo (Additional Member). The full 2012 EC is introduced on page 3 of this Newsletter, and members of the EC may be contacted via the email links provided on the ORSSA website (www.orssa.org.za). Please contact them should you have any suggestions as to how the Society may improve the service it provides to its members.

The important role that operations researchers and ORSSA can and should be playing in the provision of quality decision support to all levels of government with respect to the facilitation of sustainable development in South Africa has become increasingly evident over the past five to ten years, as so eloquently articulated by numerous delegates at our last three national conferences in Stellenbosch, Polokwane and Victoria Falls. This should indeed be one of our main priorities. We are uniquely positioned to use our scientific skills and training to help solve the many and severe problems faced in service and utility provision as well as infrastructure maintenance, to name but two areas of public service delivery where we can make a (significant!) difference. Why are our members not as effective as we may be in this regard? There may be many reasons: We may not know how and where to become involved, our marketing skills may be wanting, we may have become disillusioned (perhaps from previous experience), believing that our voices will not be heard or heeded, or, worst of all, we may not be interested in making a difference.

I would like to take this opportunity to encourage each member of ORSSA to make a conscious effort to use their operational research work to try to make a difference by contributing to the debate preceding decisions by municipalities and all levels of government on matters related to the development and improvement of our society in general. And most of all, not to give up if, at first, you feel your voice is not heard. You may recall that the 2009 Tom Rozwadowski medal was awarded to Hannelie Nel for her 2008 paper together with Stephan Krygsman and Tom de Jong, titled *The identification of possible future provincial boundaries for South Africa based on an intramax analysis of journey-to-work data* which was published in Volume 24(2) of ORiON. I am happy to report that in February 2012 Hannelie was invited to present the work in the paper to a select committee of parliament. So here we have a rare example of operational research work by a member of our Society which has been noted at the highest levels of government. Congratulations to Hannelie, Stephan and Tom! It is my sincere wish that future decisions about provincial boundaries (and indeed, in time, also other government decisions) will be based, to some extent at least, on good, objective analyses and operations research models instead of being driven merely by politics.

Would it not be fantastic if government were to slowly become convinced of the benefits of valuable decision support that we as operations researchers are able to

New ORSSA Executive Committee 2012

President:
Jan van Vuuren

Vice-President:
Dave Evans

Secretary:
Tanya Lane-Visser

Treasurer:
Marthi Harmse

ORiON Editor:
Stephan Visagie

ORiON Manager:
Martin Kidd

Newletter Editor:
Mark Einhorn

Newsletter Business Manager:
Danie Lötter

Webmaster:
Jason Matthews

Database Manager:
Ian Durbach

Chapter Chairs: Johannesburg: Louis Dannhauser
Pretoria: Winnie Pelser
Vaal Triangle: Hennie Kruger
Western Cape: Margarete Bester

IFORS Representative: Hans Ittmann

EURO Representative: Theo Stewart

New ORSSA Executive Committee 2012 (Continued)

Additional members:

Elias Munapo

'Maseka Lesaoana

Elias Willemse

offer them! So let us renew our efforts to try to influence local and national government decisions with respect to infrastructure maintenance, service delivery, basic utility provision, healthcare, education, crime prevention and other aspects of balanced development in a scientific manner by doing what we do best: practicing the science of better with a view to serving the people of our country and our continent! I would welcome any suggestions as to how ORSSA can help to maximise the effect of its members' work by providing a platform from which you can make your voices heard.

Let me close by reiterating that I am looking forward to working together with the EC this year to continue making our Society a vibrant and professional home for all our members! If anyone has any specific suggestions with respect to improving the quality of service ORSSA provides to its members or any ideas that they would like to see implemented, please do not hesitate to contact me at the email address above.

Retired Member Fees Notice

It has been decided by the Executive Committee that from 2012 onwards all **new** Retired Members will no longer receive membership benefits for free as the Society cannot afford it. Instead Retired Members will be charged the same as Student Members. All current Retired Members will continue to receive member benefits free of charge.

Student Member Notice

This notice serves as a reminder to all of our student members that they are able to place a brief CV advertorial in the newsletter free of charge. They are encouraged to make use of this opportunity when completing their studies as the newsletter is circulated among numerous OR-related industries many of whom may have vacancies they are looking to fill. Please send all submissions to the editor at 14854937@sun.ac.za

The Potential of Self-Organisation in Traffic Control

by Alewyn Burger, Mark Einhorn and Jan van Vuuren*
Department of Logistics, Stellenbosch University

Traffic in the 21st century

In a recent survey carried out by IBM [2], it was found that in the United States of America alone, as population grew by nearly 20% during the period 1982 – 2001, traffic volumes increased by 236%. Today, there are over one billion cars on the road worldwide, and this number is expected to double by 2020. In the same report, increased traffic volumes are cited as one of the main causes of the annual loss of 3.7 billion man-hours spent in congested traffic. More than 2.3 billion gallons of fuel are burnt needlessly every year in the United States alone due to people being delayed by traffic. These losses equate to a cost to the American economy of $78 billion per annum.

However, the debilitating consequences of traffic congestion are not experienced in the USA alone, but indeed the world over. In a second survey by IBM, entitled *Frustration Rising: IBM 2011 Commuter Pain Survey* [3], over 8000 motorists from 20 of the world's leading 65 cities (based on size and economic activity) were surveyed to investigate the effects of traffic on their daily lives in terms of factors such as stress, anger, health and performance at work or school. The findings of the survey were not promising.

Based on the above facts, it is clear that improving the flow of traffic along urban roads may be expected to yield significant economic, environmental and social benefits by reducing the amount of time commuters are required to spend in traffic.

Certain measures have been introduced in cities around the world in an attempt to alleviate traffic congestion. These include the improvement of more affordable public transport systems, the introduction of tolling systems which require vehicles to pay a congestion charge for the use of the city streets, as well as co-ordinated and vehicle-automated traffic control systems. One relatively new proposed vehicle-automated control technique utilises *self-organisation* in an attempt to minimise vehicle waiting times and reduce queue lengths in a traffic network.

What is self-organisation?

Self-organisation is an optimisation technique inspired by numerous processes which occur in nature. One such example in nature is the organisation abilities of bees. Bees possess the ability to successfully organise complex social interactions without any form of centralised command and control. The brain of a honey-bee is minuscule when compared to that of a human, comprising only approximately one million neurons, and yet bees are able to facilitate community defence, environmental control, food production and manufacture, reproduction and rearing of their young. Bees achieve this organisation according to a swarm-like response to social interactions and environmental triggers, such as predators, rather than being governed by a higher, centralised authority.

Serugendo *et al.* [5] define a self-organising system as follows:

"A self-organising system functions without central control, and through contextual local interactions. Components achieve a simple task individually, but a complex collective behaviour emerges from their mutual interactions. Such a system modifies its structure and functionality to adapt to changes to requirements and to the environment based on previous experience."

Self-organising traffic light control

An alternative to the typical global optimisation approach of traffic control regimes is the implementation of a decentralised self-organising system of traffic signals which allows the system to "discover for itself" the most effective local traffic signal timings as a function of the current traffic situation and how to adjust itself accordingly. A consequence of each intersection in a traffic network being optimised locally in terms of throughput is that a global ripple-effect occurs, resulting in a natural system-wide traffic signal

synchronisation among intersections as opposed to the co-ordinated synchronisation attempted by global optimisation techniques. The data required by traffic control algorithms are commonly provided by some form of vehicle detector. Electro-magnetic induction loops are the most widely used form of vehicle detection equipment in traffic control. Recent developments in technology, however, have seen the introduction of radar systems which, when mounted on a traffic light, effectively allows a traffic light to "see" a certain distance down a stretch of roadway, enabling the controlling algorithm to perceive the number of vehicles approaching the intersection (and their respective velocities).

A self-organising traffic control algorithm

An example of one such self-organising algorithm is that proposed by Lämmer and Helbing [4]. Their approach assumes a priority-based control of the traffic signals at an intersection, determined by the anticipated vehicle flows approaching the intersection. The heuristics on which their work is based were inspired by observations of self-organising oscillations of pedestrian flows at bottlenecks – in particular how the passing directions of people through a doorway changes when the "pressure" due to the number of people waiting to pass through the doorway exceeds that on the other side of the doorway by a sufficient amount. In terms of traffic control, the vehicles may be viewed as pedestrians, and the bottleneck may be seen to represent an intersection.

The above-mentioned heuristics combine two separate strategies, an *optimising prioritisation strategy* and a *stabilisation strategy.* The optimising prioritisation strategy uses dynamic priority indices to define the aforementioned "pressures" associated with each approach to an intersection. The dynamic priority index of approach *i* at time *t* is denoted by $\pi_i(t)$ and service is provided to the traffic flow achieving the greatest priority.

The stabilisation strategy ensures that traffic demand does not exceed the intersection capacity. It is introduced to complement the optimising prioritisation strategy in the form of an ordered priority set, Ω. The argument of a traffic flow is added to the ordered priority set if the anticipated number of vehicles along it expected to require service, $\hat{n}_i(t)$, exceeds some critical value, $\hat{n}_i^{crit}(t)$. Once an argument has been added to Ω, it is removed after the corresponding queue has been cleared, or else if the corresponding traffic flow has received a green signal for a certain maximum allowable green time, $g_i^{\max}(t)$.

The final overall strategy is then a combination of these two complementary regimes, the first being an optimising prioritisation strategy which attempts to minimise the waiting times of vehicles along all approaches to the intersection by serving all incoming traffic as quickly as possible, while the stabilisation strategy intervenes only if the prioritisation strategy fails to maintain the anticipated vehicle queues below some threshold value. Thus, as long as Ω is non-empty, the control strategy is always to serve the traffic flow corresponding to the first element (head) of Ω. If Ω is empty, the traffic lights follow the prioritising optimisation strategy.

Implementation of self-organising traffic control algorithms

In a recent study, Einhorn [1] conducted an investigation into the effectiveness of self-organising traffic control strategies compared to optimised fixed time control strategies as well as a case study in which the self-organising traffic control algorithms were compared to currently implemented techniques at the Bird Street and Adam Tas Street intersection in Stellenbosch, South Africa.

The study was conducted in a simulated environment using a traffic simulation model that was built specifically for the study and allowed for the implementation and investigation of various traffic control algorithms. The model was designed and implemented using the simulation software suite AnyLogic 6.5.0 [6] and utilises agent-based modelling techniques, or, more specifically, the modelling and simulation of systems that consist of autonomous, interacting individual agents. An example of the visual output of the simulation model is shown in Figure 1.

In the study, the self-organising algorithm proposed by Lämmer and Helbing [4], as described earlier, was used as a template, with two variations of the optimising prioritisation strategy being investigated.

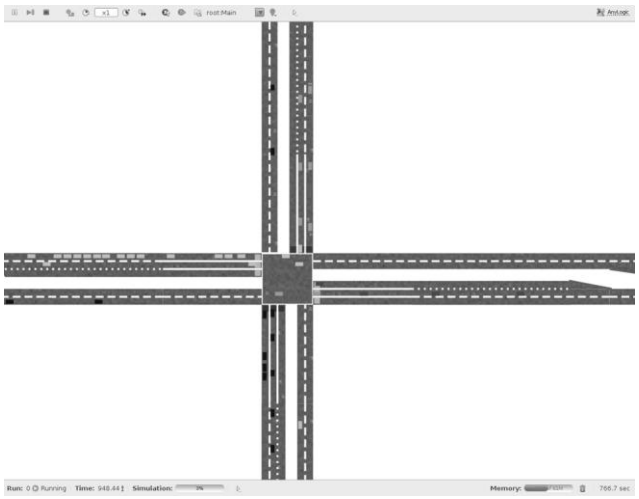


Figure 1: An example of the visual output of the simulation model of Einhorn [1], showing an intersection viewed from above.

The first optimising prioritisation strategy considered as part of self-organising traffic control algorithm I (SOTCAI) was that proposed by Lämmer and Helbing [4], and is given as follows:

$$\pi_i^I(t) = \frac{\hat{n}_i(t)}{\tau_{i,\sigma}^{pen}(t) + \tau_i(t) + \hat{g}_i(t)} .$$

Without going into too much detail, the priority index $\pi_i^I(t)$ in the above expression may be interpreted as a representation of the anticipated average service rate, or, more specifically, the anticipated number of vehicles expected to receive service, $\hat{n}_i(t)$, during a time period of length $\tau_i(t) + \hat{g}_i(t)$. Here, $\tau_i(t)$ is the remaining setup (amber and all-red) time of the traffic signal of traffic flow *i* and $\hat{g}_i(t)$ is the amount of green time that has been calculated to serve the anticipated number of arriving vehicles along traffic flow *i.* The definition of $\pi_i^I(t)$ depends on the anticipation of vehicle arrivals and the green time required to clear them, and takes into account the time losses associated with switching service from one traffic flow to another, as well as switching service back, accounted for through the inclusion of the term $\tau_{i,\sigma}^{pen}(t)$.

The second optimising prioritisation strategy investigated as part of self-organising traffic control algorithm II, (SOTCAII), proposed by Einhorn [1], is

$$\pi_i^{II}(t) = \sum_{j=1}^{n} \frac{1}{\mu + S_{j,\beta}^i} .$$

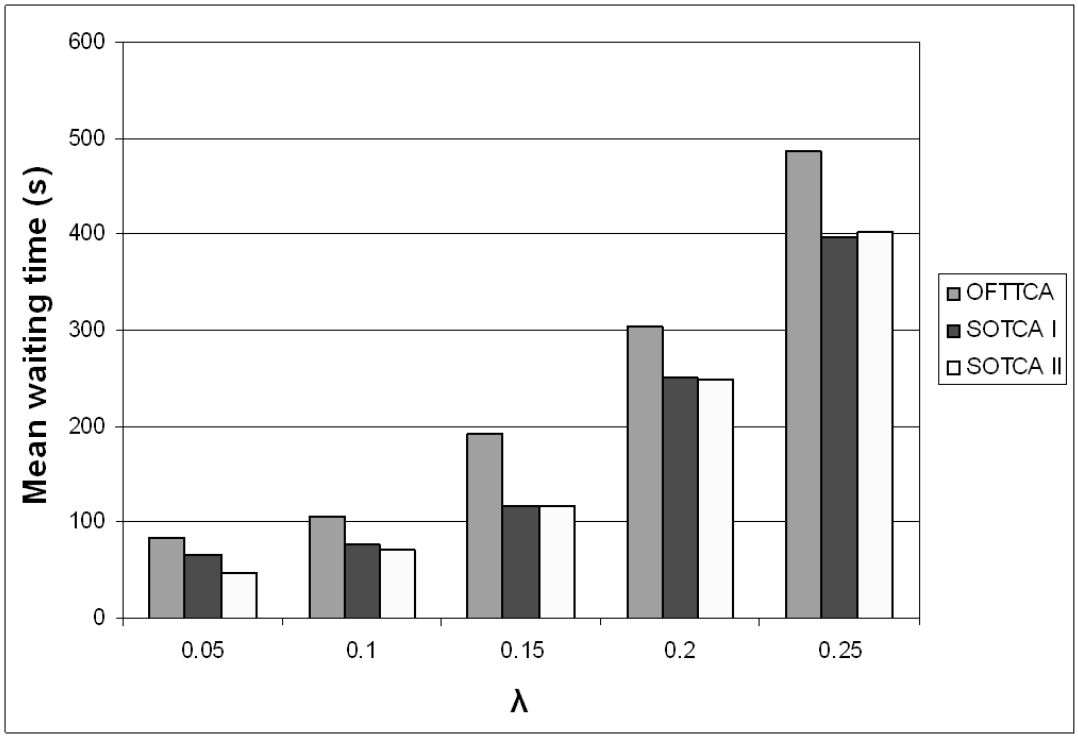


Figure 2: Simulation results obtained for a three-by-three grid of intersections in terms of the mean waiting times experienced by vehicles in the system.

In the above expression, μ is a positive constant and $S^{i}_{j,\beta}$ represents the distance between vehicle *j* along traffic flow *i* and the intersection stop line, β of the road section, where $j = 1,\ldots,n.$ Here, $\pi_i^{II}(t)$ may be interpreted as approximately the sum of the inverse distances between the detected vehicles along traffic flow *i* and the stopping point of the road section they are travelling along.

Results

The algorithms were tested for a single intersection, a two-by-two grid of intersections and a three-by-three grid of intersections, as well as for the Bird Street and Adam Tas Street intersection in Stellenbosch, South Africa. The performance measures considered when comparing the effectiveness of the various algorithms included the *mean waiting times* of vehicles in the system (a vehicle was considered to be waiting, or queued if it was not travelling at its desired speed *i.e.* the speed limit), the *mean total time* spent by vehicles in the system and the *total mean queue lengths* along all roadways in the system. All inter-arrival times between vehicles entering the system were modelled stochastically according to a displaced exponential distribution with parameter λ which ensures a minimum inter-arrival time between consecutive vehicles. It corresponds to a Poisson process with an arrival rate of λ, interrupted immediately after each arrival by a predetermined time period.

The algorithms were tested for various values of the arrival rate parameter λ and for each traffic network topology. The results obtained in terms of the mean waiting times of vehicles in the system for self-organising traffic control algorithm I, (SOTCAI), self-organising traffic control algorithm II, (SOTCAII), as well as the optimised fixed time traffic control algorithm, (OFTTCA) , are shown in Figure 2 for a three-by-three grid of intersections. In Figure 2, it may be seen that there is a significant reduction in the mean waiting times of vehicles present in the system when the self-organising algorithms are implemented relative to those achieved when an optimised fixed time traffic control algorithm is implemented. This may be attributed to the increased flexibility of the self-organising traffic control algorithms as they use any available free intersection capacity to serve all arriving vehicles efficiently. This is most noticeable for higher arrival rates. It is also interesting to note that for lower arrival rates (λ ≤ 0.1) SOTCAII is the best performing controlling strategy. This indicates that for lower traffic volumes the optimising prioritisation strategy of SOTCAII is more efficient than the optimising prioritisation strategy of SOTCAI due to the fact that for lower traffic volumes, the allocation of service is predominantly determined by the optimising prioritisation strategy of the algorithm rather than the stabilisation strategy.

Current work at Stellenbosch University

Due to the promising results of work up until this point, Einhorn [1] is continuing the study on PhD level at Stellenbosch University in an attempt to improve upon the simulation model used as well as to include further investigation into novel and more efficient self-organising traffic control algorithms.

References

[1] Einhorn MD, 2012, *An evaluation of the efficiency of self-organising versus fixed traffic signalling paradigms*, MSc Thesis, Stellenbosch University, Stellenbosch.

[2] International Business Machines, 2007, *The roads to a smarter planet*, [Online], Available from http://www.ibm.com/smarterplanet.

[3] International Business Machines, 2011, *Frustration rising: IBM 2011 commuter pain survey*, [Online], Available from http://www-03.ibm.com/press/us/en/presskit/35314.wss.

[4] Lämmer S & Helbing D, 2008, *Self-control of traffic lights and vehicle flows in urban road networks*, Journal of Statistical Mechanics: Theory and Experiment, **2008,** p. P04019.

[5] Serugendo., 2004, *Self-organisation: Paradigms and applications*, Lecture Notes in Computer Science, **2997**, pp. 1-19.

[6] XJ Technologies, 2010, *AnyLogic*, [Online], Available from http://www.xjtek.com/

MEMBER INTERVIEW: ANTON DE VILLIERS

Contactable at: 14812673@sun.ac.za

Anton de Villiers

Anton de Villiers was born in Bellville in 1987 and attended Durbanville High School. He finished school at Durbanville High school in 2005 in the Western Cape and then enrolled for undergraduate studies in the Mathematical Sciences at Stellenbosch University in 2006. He followed this up with an Honours and Masters degree in Operations Research at the University of Stellenbosch. He is currently doing a PhD in Operations Research and has been a student member of ORSSA since 2009.

How and when did you first come to be involved in OR and what aspects of OR attracted you to it?

Operations Research has always been a field of great interest to me. In 2007, I enrolled for two Operations Research modules while busy with my bachelors degree at Stellenbosch University. I had no idea of what OR was or how it would influence my life. I then decided to continue with OR upon finishing my bachelors degree. The limitless scope of OR with its vast spectrum of tools to solve practical and theoretical problems has always intrigued me.

It seems as though OR is a diamond in the rough. It encompasses hidden exceptional characteristics and future potential, but somehow lacks the final touches that would make it truly stand out. I think this is because OR is a relatively new field of study and does not have the extensive history of some other related fields. It is our job to put this into context and promote OR for its capabilities.

How and when did you become a member of ORSSA and how long have you been a member?

I have been a member of ORSSA since 2009. Since 2009, it has always been great to receive the newsletter which provides one with a good read of current work done in South Africa on OR. However, my real passion is for the ORiON. I have been the typesetting assistant for ORiON since 2010. Working on the ORiON team has allowed me to be apart of the nuts-and-bolts of some great OR work, locally and internationally.

What are your views on ORSSA and promoting OR in Africa?

ORSSA is a great ambassador for OR in Africa. I think ORSSA is currently doing an excellent job in spreading the need and importance of OR. Furthermore, holding the ORSSA 2011 conference in Zimbabwe has demonstrated the distances over which ORSSA is willing to go to spread OR throughout Africa. I hope this kind of outreach will continue in the future.

What have been the highlights of your OR career?

Definitely handing in my MSc thesis! There are many other highlights which include presenting at the 2009, 2010 and 2011 ORSSA conferences, being able to work closely with Prof Stephan Visagie during my Masters and, obviously, working on ORiON. I am aiming to contribute towards OR in the coming years during the period when I will be working on my PhD and also thereafter.

You recently submitted your Masters thesis. Can you provide some brief details about the nature of this study?

Order picking is the most important activity in distribution centres. It involves the process of retrieving products from storage in response to a specific customer request. I considered the order picking system in a distribution centre used by *Pep Stores Ltd.* (Pep), located in Durban, South Africa, in my thesis. The order picking system in Pep utilises a picking line. The system requires that the pickers move in a circular fashion around the picking line.

The planning of picking lines may be divided into three tiers of decisions. The first tier determines which *Stock Keeping Units* (SKUs) should be allocated to which picking line and is known as the *SKU to Picking Line Assignment Problem* (SPLAP). The second tier, the *SKU Location Problem* (SLP), considers the positioning of the

various SKUs in a picking line. The final tier considers the sequencing of the orders for pickers within a picking line and is referred to as the *Order Sequencing Problem* (OSP). Collectively, these three tiers aim to achieve the objective of picking all the SKUs for all the orders in the shortest possible time. The decisions associated with each tier are made sequentially during the planning of a picking line. Each problem therefore relies on the information generated by its predecessor tier(s).

In my thesis I considered all three tiers. However, the OSP and the SLP were investigated in more detail. This work has been my most significant contribution towards OR to date.

You are currently pursuing your PhD. Can you give a brief outline of your research topic for this study?

This research is concerned with edge criticality in secure graph domination. This work is a totally new front and is proving to be very interesting.

If the vertices of a graph *G* denote physical stations to be secured or patrolled in some setting, and the edges model links between these stations along which patrolling guards may move, then a secure dominating set of *G* represents a collection of station locations at which guards may be placed so that the entire station complex modelled by *G* is protected in the sense that if a station *u* is attacked, there will either be a guard at that station who can deal with the attack, or else a guard dealing with the attack from an adjacent station *v* will still leave the station complex protected after he moves from station *v* to station *u* in order to deal with the attack. In this setting the additional costs in terms of the additional number of guards required (over and above the minimum represented by the secure dominating number of the graph) to securely dominate a graph is sought when a pre-specified number of edges are removed randomly from the graph.

The notion of edge criticality is important, because one might seek the cost (in terms of the additional number of guards required to protect a station complex modelled by the underlying graph) if a number of edges in *G* fail (*i.e.* a number of links are eliminated form the station complex and hence that guards may no longer move along such a disabled link).

Similarly, one might seek the savings (in terms of edge removals) if a graph *G* contains an excess amount of guards in addition to the minimum number required for the secure domination of *G*. A feature article on my PhD topic was included in the December 2011 issue of the Newsletter.

What is your message to other young and aspiring OR practitioners?

The best advice I can give is to be aware of the possibilities of OR. The vast scope of OR may makes it difficult to be "clued up" with everything that OR has to offer. It is necessary to focus on certain aspects, but a general understanding outside one's range of expertise is crucial.

Nominations for ORSSA Awards

Nominations are now open for the 2012 round of ORSSA Fellowship and Recognition Awards. Individuals considered for the high distinction of fellowship should typically have served the Society in an exemplary manner for a considerable period of time, or should have served the science and profession of Operations Research over a considerable period of time. Recognition Awards may be made in one of the following three categories:

- Category I: To a retired member of ORSSA for outstanding contributions, typically over a long period of time
- Category II: To a current member of ORSSA for a single, outstanding achievement with respect to the practicing of OR on a national level
- Category III: To a non-member of ORSSA for outstanding contributions, typically over a long period of time

Any member of the Exec (or of the Society, for that matter) may nominate a Full Member of ORSSA for consideration of any one of these four distinctions, by submitting the following documentation to Jan van Vuuren at *vuuren@sun.ac.za:*

- Full names and contact details of the nominator,
- Full names and contact details of a seconder,
- Full names and contact details of the nominee,
- A detailed motivation for the nomination.

The closing date for nominations is May 30th.

The Tom Rozwadowski award: Nominations now open

The Tom Rozwadowski medal is the Society's premier award and has been awarded almost every year since its inception in 1971. The medal is awarded for the best paper published in a local or international peer-reviewed Operations Research journal by a member of the Society during the previous year; 2011, in this case.

The nominating committee invites submissions for consideration for this award. Nominations should be submitted to the chairman of the nominating committee, the ORSSA Vice-President, Dave Evans, (davee@dbsa.org, or post to DW Evans, PO Box 1234, Midrand, 1685.)

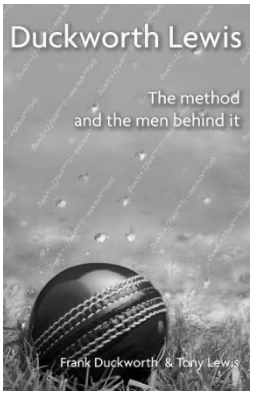
The closing date is 20th May 2012.

The following rules apply for the Tom Rozwadowski award:

1. Contributions of an OR nature published in journals of international standing during the previous year, are eligible for consideration.
2. Confidential or secret material will not be accepted for consideration.
3. Only persons who were members of the Society, or who had already applied to become members of the Society when the contribution was made, are eligible for the award.
4. Contributions will be screened by the nomination committee, consisting of the vice-president (convenor) and the chapter chairpersons, and adjudicated by a selection committee, consisting of the president, the vice president and two members of the executive committee, which will consider the material submitted by the nomination committee.
5. Any member of ORSSA may submit a contribution for consideration or draw it to the attention of the nominating committee, whether they are an author or not.
6. The nominating committee shall submit at least two contributions to the selection committee.
7. The selection committee may appoint expert referees for all of the contributions under consideration.
8. Should a member of the selection committee be under consideration for the award, he/she shall recuse him/herself, and a replacement member shall be co-opted to the selection committee by the members of that committee.
9. Where the winning material was produced by co-authors, every co-author who meets the membership criterion in point 3 above shall receive a medal.
10. One or more of the following criteria may be used as a basis for making the award:
    - 10.1. Originality,
    - 10.2. The quality of any theory developed,
    - 10.3. Interaction between theory & practice,
    - 10.4. New areas of application,
    - 10.5. New opportunities created for Operations Research,
    - 10.6. Clarity of exposition.
11. Contributions should be in English.
12. Members are encouraged to participate and the chapter chairpersons, in particular, are requested to ensure that all worthy material originating in their region is brought to the attention of the Nominating Committee.

Duckworth Lewis – The method and the men behind it.

by Hans Ittmann (hittmann01@gmail.com)



Sports have world-wide appeal and attract millions of spectators. More and more operations researchers are using OR and quantitative methods in sport. Frank Duckworth and Tony Lewis are certainly the most famous operations researchers internationally and arguably also the most famous modern partnership in cricket. Cricket is played in most countries but the countries that currently compete at the highest level include England, India, Pakistan, Sri Lanka, Bangladesh, Australia, New Zealand, South Africa, Zimbabwe and the West Indies. It is a game, with some similarities to baseball, which traditionally stretches over a number of days. In the early 70's the limited over, one-day version of the game was introduced to make it more exciting and spectator-friendly. Both teams have 50 overs to bowl (there are 60 and 40 over versions and lately also 20 over matches) with 10 wickets (or batsmen that need to be dismissed) in hand. Initially the one team bowls while the other team bats and the idea is to get as many runs as possible before all the batsman are dismissed or all the overs have been bowled. Many times nature interferes during these matches with, for example, rain interruptions or bad light stopping play, and the challenge then is how to adjust the targets in a fair way during these one-day matches. The dilemma is illustrated very well with what happened during the world cup semi-final between England and South Africa in 1992 at the Sydney Cricket Ground. It was a 50 over match and England scored 252. South Africa in turn needed to get 253 to win. South Africa were 231 for 6 wickets and needed 22 runs from 13 balls with 4 wickets in hand and then it started raining. At that stage the match could have gone either way. The match resumed but with the rules ("Most Productive Overs" method) that were used at that stage, South Africa had to get the 22 runs with just one ball! There was an outcry and the match ended in a farce. Something had to be done which was fair and that is where Duckworth and Lewis stepped in.

Duckworth Lewis, the book, is somewhat autobiographic and in the first two chapters both authors introduce themselves giving their respective stories. They tell about their backgrounds and how they became interested in designing a method which could be used to address the problem of setting fair targets in rain interrupted one day matches. Both have strong quantitative backgrounds and both were interested in sports in general and cricket specifically. Independently they started considering the challenge facing cricket. In chapter 3 they give their view on why a proper method was required. In the next chapter they describe how they came to know of each other and how they then combined forces. Early on, Duckworth presented a paper on this topic. Lewis heard about this, obtained a copy and at some point they made personal contact. So typical of the way things happen in the research arena. It turned out they lived fairly close to each other and met face to face in January 1995. A conveniently located pub became their future meeting place! As is the case with most formulas that are developed they had a formula, but realised it was wrong and it required refinement. It was wrong because the question it should have been trying to answer was: "*How many runs can be made, on average, with* u *overs remaining and* w *wickets down*?" This is the essence of their insight and contribution, the realisation that in limited over cricket there are two resources that are critical – namely the overs that remain and the wickets in hand. Using data from hundreds of past matches, where the runs scored at the fall of each wicket was captured, they started to develop and refine the method. A number of things then happened. They approached the Test and Country Cricket Board and made a presentation on their approach while they also formally agreed to join forces. Duckworth was to concentrate on

the computer code that they developed and Lewis on "methods of presentation".

In chapter 5 they describe the efforts in presenting their method to the International Cricket Council (ICC). The response from the ICC members was mixed. However, soon afterwards the Zimbabwe Cricket Council announced they would use it during the tour of England; this was at the end of 1996. The first time the Duckworth/Lewis(D/L) method was actually used was on New Year's Day 1997 when the second one day match was interrupted by rain. There were sceptics—especially amongst the media. They were not mathematically oriented and found it difficult to understand the method. There were even jokes about the method. Duckworth and Lewis made a few critical decisions during this period. They presented the method to peers at a Statistical conference. There were some teething problems initially and everything was not totally correct, but the two decided to remain quiet – not to confess that there were minor mistakes and corrected these behind the scenes. In addition it was crucial to communicate and present the method in a simple, understandable way. Towards the end of 1997 more and more of the countries started to accept and adopt the method. For the 1999 Cricket World Cup a comprehensive guide, in the form of a booklet, was produced. The method was used successfully and shortly after this World Cup it was declared to be the official standard throughout the world. Frank Duckworth and Tony Lewis became famous celebrities in cricketing circles!

As the method was used more and more frequently some changes were required and these are discussed in chapter 9. It was during this period that the first paper outlining the method was published in the *Journal of the Operational Research Society* (1998, Vol. 3, No. 3, pp.220-227). Various challenges were experienced through the use of the method across the world and these are covered in the next chapter. Duckworth and Lewis received many invitations to important cricket matches where they were the guests of the cricket authorities. However, the two clearly expected more and this they elaborate on in chapter 11. In this chapter they possibly go a bit overboard in terms of expressing their expectations of being treated much more as celebrities by the cricket authorities.

Cricket is constantly changing and a new limited over version of the game was introduced, namely Twenty20. This posed some challenges to the method and some refinements were required. Nevertheless the D/L method can also be used in this case. In chapter 14 the authors ask the question "What of the Future?" Over time they have developed a number of enhancements and "fringe" proposals, but have not been successful in convincing the authorities to implement these. The last two chapters address the issue of "fame without fortune" and what they believe "the secret was to their success". There are a number of appendices focussing on describing the method and how it works plus a section of frequently asked questions. A full list of notations, abbreviations and symbols are given as well as a comprehensive bibliography, and the D/L tables.

The Duckworth/Lewis method has been used successfully worldwide for the past 15 years now. The individuals who developed this method have between them published five of their papers on the topic in the *Journal of the Operational Research Society*. For their services to cricket and also to the mathematical sciences they both received MBEs in June 2010. They are indeed the most famous operations researchers! Their book *Duckworth Lewis* is not only a fascinating story but it also explains the development of the method and how it works in detail. Both OR people who love sport, particularly cricket, and ordinary cricket followers will enjoy this book immensely.

Book info: ***Duckworth Lewis – The method and the men behind it*** **by Frank Duckworth and Tony Lewis, 2011, SportsBooks Limited, Cheltenham, UK, pp. 213. ISBN: 9781907524 00 4. 19.17 US dollars.**

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

Anticipated Registration Fees

Delegate Category	Fee
Student Early Member	R 1450
Non-student Early Member	R 2450
Student Non-early member	R 1550
Non-student Non-early Member	R 2550
Student Early Non-Member	R 1650
Non-student Early Non-member	R 2650
Student Non-early Non-member	R 1750
Non-student Non-early Non-member	R 2750

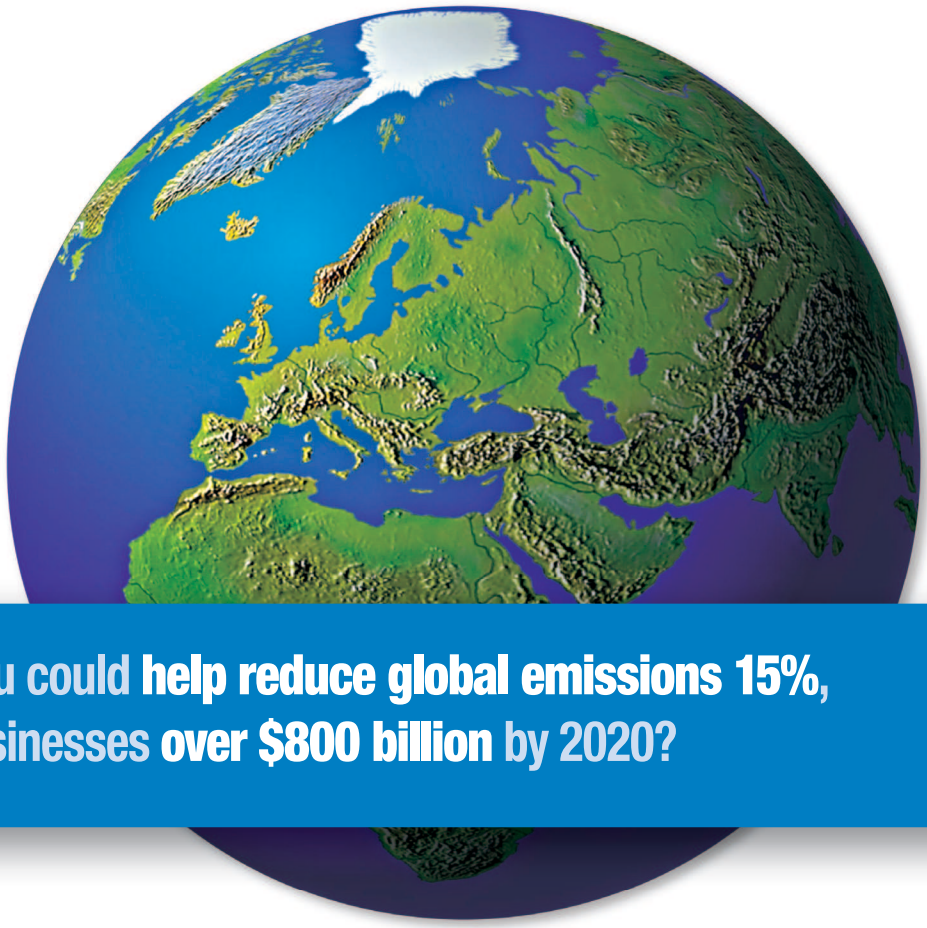
Please visit the conference website for more information:

www.orssa.org.za

(click on *2012 Conference)*

SAS® for Sustainability Management

Predictive Analytics | Performance Reporting | Carbon Footprint Modeling | Data Management
Resource Optimisation



What if you could **help reduce global emissions 15%,** saving businesses **over $800 billion** by 2020?

You can. SAS gives you The Power to Know.®

SAS for Sustainability Management enables your organisation to measure, manage and report on environmental, social and economic indicators, as well as develop business strategies that reduce risk and increase brand value.

▸▸ **www.sas.com/sa**
for a free white paper

sas | THE POWER TO KNOW.