Operations Research Society of South Africa

AT THE FOREFRONT OF ANALYTICS IN AFRICA

50 years of FABULOUS

ORSSA Newsletter October 2019

www.orssa.org.za

From The Editor

By Brian van Vuuren
(brianjohnvanvuuren@gmail.com)

Brian van Vuuren

Dear ORSSA friends,

As is tradition – this quarter's newsletter is dedicated to documenting the annual conference so that those who were there can re-live the highlights and good memories, whilst those who weren't can hopefully get a taste of what they missed out on! And, wow – what a conference it was!

I was fortunate enough to be able to attend and I thoroughly enjoyed myself. I think everyone who attended will agree that the local organising committee, chaired by Lieschen Venter, did an outstanding job on all fronts. Well done and thank you to each and every member for the time and effort you put into marking such a special occasion and year in the society's history!

On a personal note, attending the conference is fast becoming less and less about the presentations. Even though they are still of a fantastically high standard and very interesting, I find that not engaging with operations research-type work regularly means that, these days, I feel like more of an *interested observer* when attending presentation, as opposed to a *passionate engager* and *potential collaborator*.

None-the-less, I'm still equally fond of being at the conference and, in some ways, find it even more important than ever before that I make a concerted effort to be there each year. I say this purely because of that one special ingredient of ORSSA that makes it such a special society to be a part of – the people.

Whether over a beer or a cup of coffee, discussing work or studies, rekindling old memories or dreaming up future plans; ORSSA conferences are just such a fantastic way to reconnect with friends and colleagues in a 'like-minded' environment. Just take the fact that, this year, I was fortunate to have a chat with Professor Gerhard Geldenhuys, a founding member of the ORSSA society! Fifty years on and his passion for operations research is as strong as ever. What an example of a gentlemen and lifelong scholar he is to us all. I'll treasure the few opportunities I have had to engage with someone of his calibre – opportunities I'd likely *never* have had, but for at an ORSSA conference!

And that's just one of many conversations – hearing about game park experiences from Professor Erwin Pesch, laughing at memories of ORSSA conferences gone by with Prof Theo Stewart, touching base with my promotor and friend, Dr Linke Potgieter; solving all of life's problems over coffee with my good friend Rob Bennetto, and so many more – it

truly is a collection of special moments and special people which form the very essence of our society.

And it's in this vein that I'd like to charge ORSSA members – young and old – to really consider what role they are playing in ensuring the long-term well-being and sustainability of our society. In the same way that a memorable conference is simply the collection of numerous special moments; so too is a healthy, long-lasting society only possible by the sum of numerous small efforts from its members.

What single thing are you doing in the year which makes ORSSA better? Not just for you, but for academics, business people, students, corporates, fellows of the society and brand new members – what contribution are you bringing to the table in order to grow, better and sustain ORSSA? We don't all (*thank goodness!*) need to be Lieschen Venters – exec members, conference organisers, minute takers, society communicators and administators, any-other-re-

Features   Page

SOCIAL MEDIA

- **Facebook:** Please visit (and like!) our page at *www.facebook.com/ORSocietySA*
- **Twitter**: @_ORSSA
- **LinkedIn:** Please visit our page at *www.linkedin.com/company/the-operations-research-society-of-south-africa*

quired-task-completers all at once. Whilst we should be *so* thankful for champions like Lieschen, a few far smaller commitments from a wider network of people would not only lighten the load, it also offers a far greater potential to project the society onwards and upwards, with new ideas and energy to continually better the offering that the society brings to the greater OR community.

So whether it's a newsletter article (*great idea!*) or simply choosing the ORiON journal for your next academic publication. It might be assisting as part of the next local organising committee for a conference in your area, or even assisting from a distance with a skillset which can be applied 'remotely'. Maybe it's a fresh, new chapter event that you offer to organise instead of simply looking to your already pressed-for-time chapter chair. It could be an active effort to grow ORSSA's corporate membership within your networks, or perhaps just a commitment to push your students/colleagues to join the society to grow our footprint within South Africa.

Yes – if we all do just a little bit, the result (and consequent progress for the society) would be astounding and, better yet, the distribution of work and responsbility on each member would be maintainable, allowing for things to be done timeously and to a high standard of quality.

I don't know about you, but I have a special place in my heart for the ORSSA society. I believe the society has given me far more than what I've given it. That's what has motivated me for the last 3+ years to be the newsletter editor

and, although I'll hang up my boots (*keyboard?*) at the end of this year, as we welcome in some fresh and exciting talent to take over, it's by no means the last contribution I'll make to the society. Instead, I see it as a chance to consider a new space in which I can make a mark.

So, I leave you with this – in the blink of an eye, you'll be reading the December newsletter, and shortly thereafter, we're done with 2019. Before you know it, the 2020 conference will be coming around. A year from now, what aspect of the soceity will you be able to point to and say "*I had a hand in making that **great**"?*

I can only imagine that when Professor Geldenhuys watches the bustling conversations over coffee, hears the shrieking laughter on the banquet dancefloor, or passionately applauds the expertly presented research as an onlooker in a conference session, that he must feel such a sense of satisfaction thinking, "*I was part of starting all of this...*"

What are you doing to continue that legacy and make the next 50 years of ORSSA even greater?

Happy 50th birthday to this wonderful society! Thank you to each and every ORSSA member who has committed contributed to making it the special, lovable community that it is.
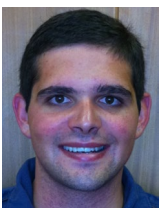
Until December,
Brian

FROM THE PRESIDENT'S DESK

BY DANIE LÖTTER
(DANIEL@GLOBELOTTER.CO.ZA)
ORSSA PRESIDENT

Danie Lötter

Greetings to all ORSSA members. As I am writing this column, we will be well on our way to Christmas and the 48th annual ORSSA conference will be a distant memory. This year the Society celebrated its 50th birthday at the prestigious convention center of the lavish Vineyard hotel in Claremont, Cape Town. This year was, yet again, a memorable event offering delegates a rich scientific program and lots of social opportunities to network with fellow members and colleagues.

Not only was the conference memorable for all the fascinating talks and events which occurred throughout the conference, but also for the individual achievements which the Society recognised at the Banquet. The 2019 Tom Rozwadowski Medal was awarded to Bernie Lindner (Department of Industrial Engineering at Stellenbosch Stellenbosch), James Bekker (Department of Industrial En-

gineering at Stellenbosch University) and Jan van Vuuren (Department of Industrial Engineering at Stellenbosch University) for a paper, entitled *Tradeoffs between levelling the reserve margin and minimising production cost in generator maintenance scheduling for regulated power systems* which appeared in Electrical Power and Energy Systems Volume 101 in 2018. Furthermore, two recognition awards were awarded at the Banquet. The first was a Category III award to Chris Swanepoel (University of South Africa) for outstanding contributions to a non-member of ORSSA over a long period of time. The second was a Category IV recognition award which was awarded to Collin Phillips (Discovery) for an upcoming member of age 35 or below for excellence in operations research practice.

Our student members also excelled and were duly awarded in the Society's national student competition at the banquet. On honours or fourth year level, the runner up was Annelie Wessels (Department of Logistics at Stellenbosch University), while the winner of the Gerhard Geldenhuys Medal for the best honours or fourth year project went to Annika Brundyn (Department of Statistics at the University of Cape Town). In the masters category, the runner up was Stephan Nel (Department of Industrial Engineering at

Stellenbosch University), while the winner of the Theodore Stewart Medal for the best masters thesis went to Jean-Pierre van Niekerk (Department of Industrial Engineering at Northwest University). Congratulations to Annelie, Annika, Stephan and Jean-Pierre!
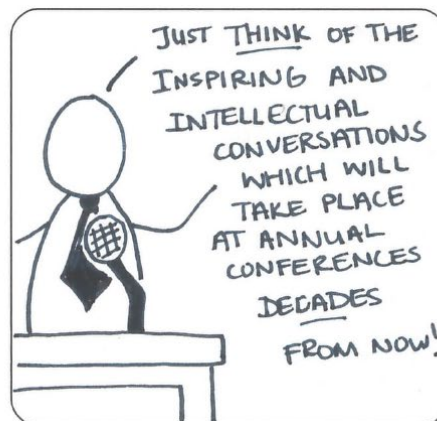
In addition, Tom Richardson (Department of Industrial Engineering at Stellenbosch University) won the prize for the best oral presentation by an honours or fourth year student at the conference, while Kit Searle (Department of Industrial Engineering at Stellenbosch University), won the prize for the best oral presentation by a masters student. Flora Hoffman (Department of Logistics at Stellenbosch University) won the prize for the best oral presentation by a doctoral student. Congratulations to Tom, Kit and Flora!

I was once again very impressed by the depth and range of the contributed paper topics at the conference. I was also inspired by the increased number of young students who attended the conference and the interesting presentations they gave at the conference. I am proud to be a member of the Society!

I would like to conclude by thanking every ORSSA member who attended the conference, presented a paper and/or helped organise the conference to make it such a huge success! I would like to thank the Western Cape chapter for organising this year's conference and in particular, the LOC which was spearheaded by Lieschen Venter for their superb and extremely time consuming job of organising the conference so well! It is much appreciated. Next year the conference will be hosted by the Vaal Triangle chapter spearheaded by Philip Venter. Details of the conference will be made available shortly on the website.

Finally, I would like to conclude by extending a friendly invitation to members of the Society to contact me should they have any suggestions as to how ORSSA can improve on the service it delivers to its members.

With my best wishes ,
Daniel Lötter

The 2019 ORSSA Conference (Academic Review)

by Brian van Vuuren (brianjohnvanvuuren@gmail.com)

For the last 50 years, the ORSSA community have been applying the trade of operations research in a variety of applications, spanning academia and industry and consistently evolving in complexity and elegance. For 47 of these years, the annual ORSSA conference has served as the platform from which these '*stories of OR*' are shared and, each year, conference attendees are treated to high quality talks presented in focused, engaging streams. Other than watching Danie Lötter on the dancefloor at the conference banquet, it really has to be the highlight of the annual conference. And the 48th conference programme was no exception!

As is fitting for a 50th birthday celebration conference, this year's event boasted three top-tier conference guests in the form of a tutorial presenter and two keynote speakers.

Professor Erwin Pesch, from the University of Siegen, kicked off the conference proceedings with a tutorial on Sunday afternoon. The tutorial served as an introduction to the design of approximation algorithms, describing some common techniques used in the construction of the algorithms, as well as illustrating a number of examples.

The first keynote speaker, M. Grazia Speranza, from the University of Brescia, delivered her address on Monday morning during the opening plenary session. The current president of IFORS addressed the use of Operations Research in transportation and supply chain management.

In this talk, Grazia discussed the different problem classes which exist in this field, as well as introduced several

interesting possibilities for the combination of different problem spaces in order to present new problem structures for which novel solutions can be found. She also proposed some 'problems of the future', which made use of modern technologies in order to solve some age-old transportation problems in fresh, interesting ways.

The second keynote speaker, Professor Gerhard Geldenhuys, professor emeritus at Stellenbosch University, delivered his address on Wednesday morning at the closing plenary session. Professor Geldenhuys brought with him a special view of the ORSSA society in that he was one of the founding members of the society some 50 years ago. Fittingly, in his address, Professor Geldenhuys reflected on the progress made by the society since its founding. Through techniques and applications of operations research in South Africa, along with the amazing growth in computing power that is now available to researchers in the field, Professor Geldenhuys assured the society that the founders would be impressed by just how far the community has come. In a thought provoking, deeply sentimental address, Proffessor Gedenhuys reflected on how the landscape of operations research has changed over the years, the networks which have been developed and the opportunities which are now open to enthusiastic researchers and employees in the field.

Other than the plenary sessions, a wide variety of interesting talks, grouped into broad topic classes, were presented accross three parallel streams. Naturally, I couldn't attend every talk and, quite frankly, it would be impossible to sufficiently summarise the talks I did attend in a few lines. I therefore encourage anyone who wasn't able to be at the conference to acquire a copy of the conference proceedings from the local organising committee. Here, each talk is nicely summarised in the form of an abstract. This will also provide insights into what work is being done and who is doing that work, should any ORSSA member wish to collaborate with someone in the field.

The talks I did manage to attend were of a very high quality and it was once again encouraging and interesting to see operations research being used in such diverse ways.

In the session on heuristics and metaheuristics, for example, Stephan Snyman compared the performance of different metaheuristics when solving a stochastic, bi-objective job scheduling problem. In this case, better solutions were those where two conflicting objectives, make-span and total overtime, were minimized. In order to determine the approximate Pareto set for the problem, a novel ranking and selection technique, MMY, was implemented. This allowed for a probabilistic guarantee of correctly selecting the best scenarios.

Following this, Angelo Mendes presented a heuristic approach towards minimizing fuel consumption in natural gas transmission networks. In this presentation, Angelo applied a new approach, based on simulated annealing, to transmission networks often considered as benchmarks for this problem. In doing so, he illustrated the flexibility and robustness of the methodology in striking a solution to the problem class which is both efficient, as well as capable of delivering solutions of a suitable quality.

Rob Bennetto spoke next in the session on evolutionary strategies in discrete optimization. He discussed the philosophy of the approach and results of a study in which constraint programming was used as an underlying solver. Using this approach, tailored search algorithms were designed for problem structures which yield returns across unseen cases, both for single and multi-objective approaches. A number of interesting benefits were demonstrated for both approaches.

In the stream on healthcare, Matthew Higgo presented an inventory model aimed at reduced overall unmet demand at public healthcare facilities. His model is designed to place orders for any facility, taking into account its lead times, review period, available storage space and product priority categorisation.

In the same stream, Ghiette van Zyl presented on graph-based, semi-supervised learning for the detection of potential disease-causing genes. This method is primarily based on the principle that the neighbour of a disease gene in a network is likely to cause the same, or similar, disease. Using this principle, as well as data related to similarity between genes, Ghiette presented the work she is conducting in the semi-supervised learning paradigm to aid in the detection of problematic genes.

Another interesting and exciting aspect of this year's conference was the launch of the coffee table book *Operations Research in South Africa - the first 50 years*. This fantastic

LOC committee chair, Lieschen Venter, kicks off the conference during the opening plenary session.

documentation of the activities in the OR space over the last half-century was the result of tireless efforts from a number of ORSSA members who authored chapters of the book.

In line with this, the conference provided various streams during which authors and contributing authors presented the research and writing which went into the respective chapters of this book.

In the first of these streams, Jan van Vuuren discussed the emergence of operations research in the international arena, providing an insightful account of the birth of operations research as a means of gaining advantage during the Second World War, through to the establishment of the multi-discipline in the public and private sectors of the United Kingdom and United States.

As always, plenty of conversation and catching up took place during tea and mealtimes.

In the same session, Gerhard Geldenhuys discussed the emergence of operations research in South Africa and the consequent founding of ORSSA, of which he formed part. In this talk, he discussed the meetings and interactions which led to the organisation of a conference at the University of the Witwatersrand in November 1969 - the very conference where the ORSSA society was founded.

In the stream covering transport, Christian Malan presented a model which aims to compare different techniques which reposition bicycles at stations in order to avoid inconsistent supply of available bicycles or parking spaces in bicycle sharing systems. By evaluating the different available repositioning strategies, the number of dissatisfied users, as well as the cost of respositioning, is aimed to be minimised.

Andries Heyns showing the camera his best side as he catches up with Handre Williams and Colin Phillips.

In the Epidemiology stream, Chrystal Udall proposed the use of simulation to model the spread of tuberculosis in informal settlements. By exploring the mechanisms of the spread of tuberculosis through the interactions of infected individuals, the model seeks to assist policy decision making and development of strategies to combat the impact of the illness.

Continuing with the theme of using simulation to combat the spread of deadly disease, Kyle van Heerden presented a simulation modelling approach to investigate the effectiveness of intervention strategies in an Ebola epidemic. This model considered financial and logistical constraints in proposing the most effective intervention strategy (*contact tracing, quarantine, safe burials and vaccination*) or combination of strategies which should be implemented to minimise the number of infected individuals.

Members of the LOC fulfilling any and every role necessary in order to host a fantastic conference!

In the second stream covering the history of OR in South Africa, Jan van Vuuren presented on the fellowship and recognition awards conferred by the ORSSA society, while Marthi Harmse spoke about operations research for development in South Africa. In her presentation, Marthi provided a brief description of development in South Africa and with particular focus on the role of operations research. Following this, the role of ORSSA, as well as academic and research institutions was discussed, whereafter by initiatives by local and international organisations, which have aided in achieving various development goals in our country.

In the transportation stream, Judene Simonis presented research wherein she evaluated some popular machine learning algorithms in terms of their ability to predict the severity of road accidents – predicted by the World Health Organisation to be the 5th leading cause of death worldwide by 2020. During the same session, Monica Rolo proposed the use of agent-based modelling to analyse the operation of a transportation network company, such as Uber or Lyft. The model aims to provide decision-support to drivers with respect to identifying suitable 'waiting locations' such that they can timeously respond to ride requests from users.
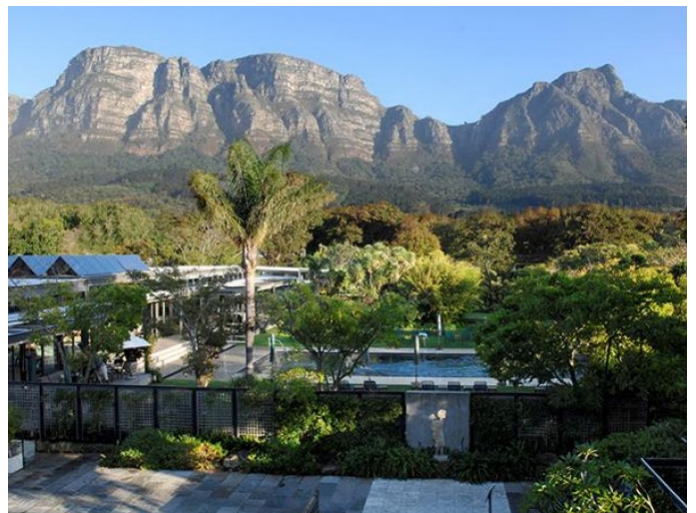
In the ecology and conservation stream, Kit Searle present-

The society was particularly fortunate to have one of its founding fathers, Professor Gerhard Geldenhuys (*right*), present for the birthday festivities; pictured here with another fellow of the society, Professor Stephan Visagie.

ed his ongoing work using spatial-temporal modelling to address the question of what rate a species can be harvested without becoming extinct. Through an analysis performed of the long-term solution behaviour of the spatial domain, Kit hopes to propose sustainable, effective harvesting techniques for specific food species. No ORSSA conference would be complete without some sort of presentation pertaining to *Eldana saccharina*, the sugarcane stalk borer pest. As such, the responsibility this year fell on DJ Human who recommended the size and layout of refuge areas in B*t* crop fields, so as to ensure the targeted pest does not develop resistance to the toxic proteins in the plant aimed to aid in its eradication. By using agent-based simulation modelling, the implantation of the recommended field layouts can be tested to determine their effectiveness on infested sugarcane farms.

In a further stream celebrating chapters of the History of OR in South Africa book, Winnie Pelser provided an account of OR in the military during the period 1945-2018.

The view enjoyed by conference attendees from the plenary venue at the Vineyard Hotel.

IFORS president, M. Grazia Speranza addressing the ORSSA community during the opening plenary session.

The military operations research carried out at defence-related institutions was emphasized, along with the work of individuals in the South African National Defence Force who conducted operations research-related work.
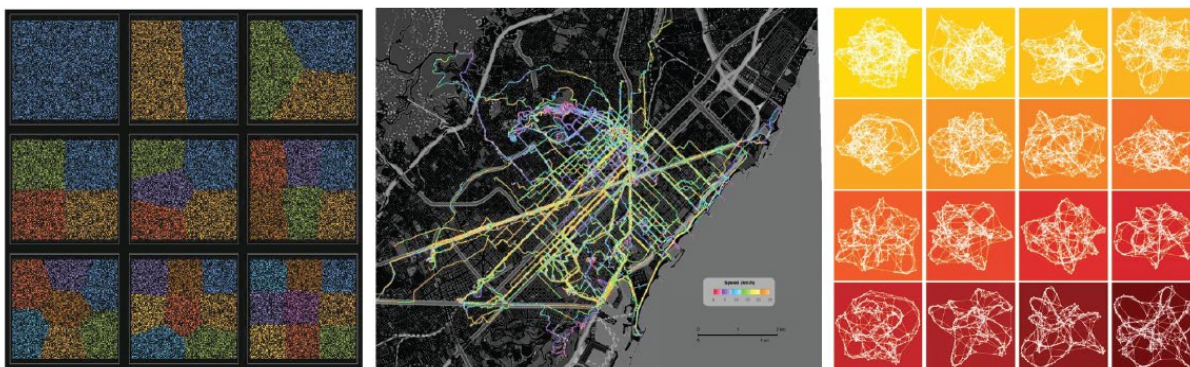
As is synonymous with ORSSA conferences, the topics covered in the various streams were diverse and creative – truly celebrating the application of operations research as a science. From applications in education, where Lieschen Venter presented her system dynamics model which seeks to determine the most prominent factors requiring intervention in order to balance performance inequality between schools in high and low socio-economic status communities, to banking and finance, where Hein von Stein presented some early results of using three neural network models, along with minimal inputs and network topologies, in an attempt to predict exchange rates more accurately than native forecast techniques. Behavioural OR applications were presented by the likes of Theo Stewart, who presented evolutionary multi-objective optimisation heuristics as a means of overcoming the problem of presenting users with Pareto optimal solutions for complex problems in a manner which does not bias the decision-maker preferences, as well as Prof Leanne Scott's account of the data science program which is currently offered at the University of Cape Town.

There was also a stream dedicated to the finalists of this year's annual student competition, where the work of the two finalists in the Honours (*Annika Brundyn and Annelie Wessels*) and Masters categories (*Jean-Pierre van Niekerk and Stephan Nel*) was presented. Details pertaining to these presentations, as well as the competition itself, are provided in a special article later in this newsletter edition.

Another field gaining traction at ORSSA conferences is machine learning – and this year was no exception – with a number of streams showing a strong influence of the popular subject matter. Paul Fatti, a self-confessed *non-machine learning expert*, presented ideas on the interpretation of

Winner of the 2019 ORSSA conference 4th Year/Honours-level student presentation award, Tom Richardson receiving his award from LOC chair, Lieschen Venter.

machine learning models, which are so often 'black box', in terms of how they come to proposed solutions. Further, improvements to human pose classification using convolutional neural networks through data augmentation were discussed in the work of Jaco du Toit.

In the more traditional operations research field of supply chain and logistics, Pieter de Wet presented an optimisation model developed to make more informed decisions for a forestry company, along with a suite of tools aimed at improving communication between different departments who are role players, as well as optimise the supply chain. In the same stream, Marno du Plessis presented a concept demonstrator of the use of reinforcement learning in supply chains facilitaties to achieve self-organisation and, in doing so, minimise stockouts globally.

Other interesting streams included urban systems, data mining, strategic planning and competition – even a 'miscellaneous' stream for work which draws on such diverse

Winner of the 2019 ORSSA conference Masters-level student presentation award, Kit Searle, receiving his award from LOC chair, Lieschen Venter.

inspirations in its implementation, it makes it difficult to classify under a specific theme. Such is the nature of work being done in the ORSSA community – it's interesting, it's diverse, it's interconnected and, most importantly, it's of an exceptionally high standard.

As always, the student presentation competition took place during the course of the conference programme. This year, Tom Richardson was awarded the prize for the best Honours/4th Year presentation, Kit Searle took home the prize for the best Masters presentation and Flora Hoffmann was recognised as the best PhD presenter during the conference. Congratulations to these stand-out presenters, among so many accomplished and professional presentations on display during the conference!

Fifty years after the society was started and the quality of the work being done by its members is still something to be proud of and to celebrate. Congratulations to all speakers and the programme committee chair for an enriching, diverse and enjoyable conference programme.

Winner of the 2019 ORSSA conference PhD-level student presentation award, Flora Hoffmann, receiving her award from LOC chair, Lieschen Venter.

LET US KNOW WHAT YOU'RE UP TO

The ORSSA community would love to hear your news. If you've taken on a new job, an interesting research topic, completed your studies or finished a noteworthy certification or course, please let us know and it may be featured in one of our upcoming newsletters. Your insights, experiences and information aren't only interesting to the community, but they also help and inspire others who are looking to do something similar. Please send all relevant information and media to brianjohnvanvuuren@gmail.com

The Experiences of a Conference Attendee

by Christa de Kock (christadk@sun.ac.za) & Kit Searle (18268420@sun.ac.za)

Christa de Kock

There was an excitement hanging in the air as the SUnORE research group prepared for the annual ORSSA conference – an event marked in our calendar months in advance! Students received a thorough briefing of the birth and mission of the society, and while the younger attendees were anxious on presenting their work at such a conference for the first time, senior students were reminiscing about previous ORSSA conferences. A great expectation was in all of us as we awaited the conference and semicentennial celebration – an event which surely exceeded our expectations!

The conference kicked off with a welcoming function at the Vineyard Hotel's Summerhouse where drinks and canapes were in abundance. The greeting of old familiar faces and being introduced to new ones, is always a highlight of the welcoming evening. The gathering was spread from those always closer to the food and drinks table, to those enjoying the fresh evening air on the open veranda and grass area.

The first plenary session was the keynote address by Prof Grazia Speranza where she talked about the major trends in supply chain management and logistics. Perhaps, the most fascinating topic was collaborative trends in transportation problems. Throughout the rest of the first day, parallel sessions entitled *History of OR in South Africa, Health Care, Epidemiology*, as well as *Ecology and Conservation* caught our attention. Prof van Vuuren delivered a very interesting presentation where he somehow managed to summarise the embryonic historical events leading up to the eventual birth of OR in 1936.

Ghiete van Zyl presented on her research where she utilised graph-based semi-supervised learning in the context of bioinformatics to aid in the detection of potential disease-causing genes. Sheetal Silal discussed a mathematical approach towards decision making in eliminating malaria in our country; we were very impressed with the work which she has done in obtaining funds to attempt to eradicate this deadly disease. Tom Richardson spoke on *Modelling the spread of fire in conservation areas*, the presentation which won the award for the best presentation by an honours student.

The first day's sessions were followed by a lovely social mixer which took place at Moyo in Kirstenbosch Gardens. Conversations ignited earlier in the day continued and a feast of snack foods were served. Wonderful initiatives were taken by the LOC in entertaining the guests, such

as the research network diagram strung with wool and the caricature sketches of well-known ORSSA members.

Kit Searle

On the second day of the conference many interesting talks were given, such as at the parallel session on *History of OR in South Africa*, where Hennie Kruger spoke on the softer side of OR and multi-criteria decision analysis – no easy feat, especially if Theo Stewart is sitting in the audience. Another interesting session was that of *Behavioural OR Meets Data Science* presented by UCT members. We thoroughly enjoyed Theo Stewart's talk on I*nterfacing human preferences with multi-objective programming* and Isabel Meyer's research into using data science in promoting positive behavioural change in the welfare sector with focus on animal welfare.

In the *Banking and Finance* session, Hein von Stein delivered a daring talk on *Foreign exchange prediction with neural networks* where Wim Gewers made the comment, 'When you succeed, never publish your findings and rather make lots of money!' During the *Machine Learning* sessions it was particularly interesting to gain some perspective on the field from the likes of Paul Fatti and Chris Swanepoel. It was time for the spectacular conference banquet at the Vineyard Hotel's Summerhouse. An evening of cheerful conversations, delicious cuisine and wine, prestigious awards, entertaining dances, and clinking glasses, as we celebrated the society's semicentennial. The party was later moved to the Vineyard Hotel's bar where we were eventually politely asked to leave, marking the end of a very successful banquet.

On the final day of the conference, during the *Optimisation* session, Robert Bennetto delivered a well-attended presentation on *Optimality proofs in combinatorics – the cutting plane approach*. In the closing address, Prof Gerhard Geldenhuys captivated the audience while sharing his insight into the continuing growth of OR and the society with analogies of storytelling, art and community. Overall, the conference was a great success and we would like to thank Lieschen Venter and her LOC for putting together a splendid conference.

HOW WAS YOUR CONFERENCE?

Did you attend the 2019 ORSSA conference? We'd love to hear about your experiences, or perhaps a summary of the work which you presented on at the conference. Email **brianjohnvanvuuren@gmail.com** with submissions or any further enquiries you might have.

The 2019 ORSSA Conference (Social Review)

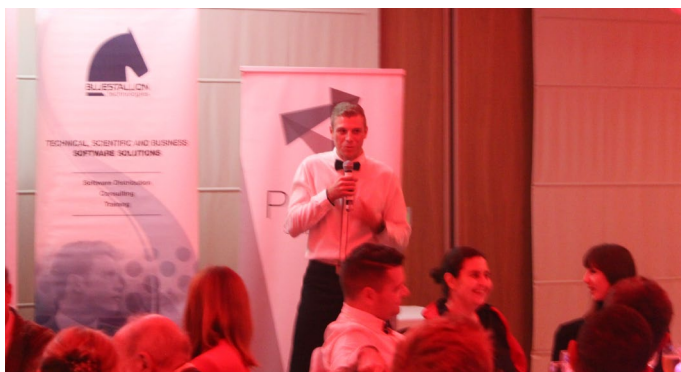### by Brian van Vuuren (brianjohnvanvuuren@gmail.com)

Brian van Vuuren

Apart from the academic stimulation, learning opportunities and collaboration possibilities offered to those who attend the ORSSA conference, there is another aspect of the conference which offers much joy and pleasure to those who can make it to the annual showpiece. In fact, some might argue it's the primary reason the same familiar faces make the effort to participate in the conference every year. I'm referring, of course, to…the conference food. Organise a plenary speaker who is a founding member of ORSSA or the president of IFORS, host the conference at one of Cape Town's most esteemed venues, even gift each conference attendee with a momentous piece of literature documenting the first 50 years of Operations Research in South Africa – it evidently falls far short, in terms of its ability to delight and energise conference attendees, in comparison to ham and cheese croissants or breakfast muffins.
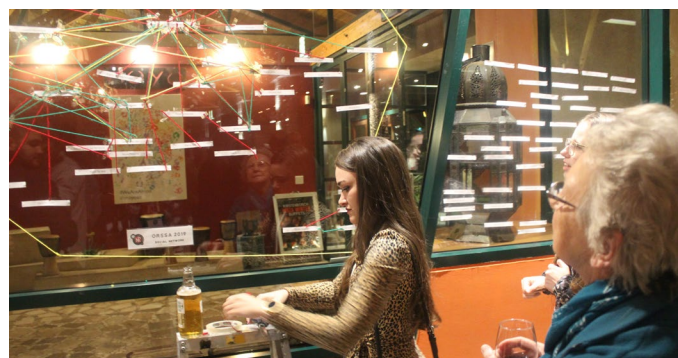
As always the numerous meal and tea-times were the social '*hustle and bustle*' of the conference and I'm quite convinced that Nespresso shares have shot through the roof given the quantity of coffee consumed at the Vineyard hotel over the three days. But, other than the delight that minature versions of otherwise normal sized foods brought, a vibrant and hugely enjoyable after-hours social programme was also offered at this year's special conference.

Conference banquet host, Thorsten Schmidt-Dumont, kept guests thoroughly entertained at the gala event on Tuesday evening.

Apart from the opening function on Sunday evening where delegates had a chance to get the "*how's your research going?*" or "*when are you handing in?*" questions out of the way, a social mixer was held at Moyo restaurant in Kirstenbosch gardens on Monday night.

Here, the conference organising committee went the extra mile to organise a few fun activities detailing just how diverse, yet interconnected the ORSSA community is.

A network map showing all the relationships between ORSSA delegates as either student-supervisors, colleagues or co-publishers.

On one end of the room, a network model was built up by event attendees which showed the connections between ORSSA members as colleagues, student-supervisor relationships or co-publishers. It was astounding to see just how connected the ORSSA community truly is, as well as inspiring to see how many lives and careers have been impacted and connected to some of the ORSSA stalwarts (*as well as how committed these leaders have been in drawing their student groups into the ORSSA community*).

Other fun activities included a histogram showing the years in which different members had joined ORSSA, as well as a 'guess the caricature' game where attendees attempted to identify the familiar ORSSA face which had been brilliantly captured in caricature form by a Stellenbosch-based artist. These thoughtful activities, combined with outstanding, traditionally South African food and plenty of drinks made for a fun-filled evening of socialising, chatting and laughter.

The Tuesday evening was, once again, dedicated to recognising and celebrating ORSSA members who have excelled in the field over the last year. The evening was hosted by Thorsten Schmidt-Dumont who 'wow-ed' the audience, both with his collection of interesting world events which took place in the same year as ORSSA was founded, as well as his astounding ability to remember so many interesting facts without any form of written assistance.

Various awards and medals were handed out on the evening, each of which is detailed in its own piece later in this newsletter. Furthermore, the official launch of the ORSSA coffee table book was recognised by Hans Ittmann and the editors, Prof Jan van Vuuren and Prof Hennie Kruger, were recognised for their monumental efforts in getting the memorable piece of literature together.

But the highlight of the evening would surely have to be

Optimise your career through research collaboration or by obtaining a degree through the Industrial Engineering Department at Stellenbosch University.

Doing it better

LOGISTICS

Supply chain

Facility planning

Push & Pull systems

Inventory management

Packing

MANUFACTURING

Bio-mechanical body parts

Machining

Micro injection moulding

Micro milling

Robotics

Rapid prototyping

Systems dynamics

ANALYTICS

Statistical analysis

Business analysis

Planning

SYNTHESIS

Simulation

Decision support

Optimisation

Economic modelling

Business analysis

MANAGEMENT

Operations management

Knowledge management

Project management

Change management

BEng (Industrial), MEng (Research) or MEng (Structured) (Engineering Management), MEng (Research) or MEng (Structured) (Industrial Engineering), PhD, Postgraduate Diploma in Engineering Management or Industrial Engineering

Industrial Engineering @ Stellenbosch University

the cutting of ORSSA's 50th birthday cake, along with an Italian rendition of "Happy Birthday" by Grazia Speranza to the society. I hazard a guess that we might be the only society ever to have had the IFORS president sing for us at our birthday event. No pressure on whoever organises the 100th birthday celebration!

All in all, it was a special couple of days, and the opportunity to catch up with old friends and colleagues, as well as make new friends and expand networks, was thoroughly enjoyed by all.

The LOC must, once again, be recognised and commended for the 'over and above' effort which went in to making these social events extra special and enjoyable. Their tireless commitment and attention to detail really made the events worthy of a 50th birthday celebration!

The 2019 ORSSA Student Competition

by Winnie Pelser (winnie.pelser@csir.co.za)

The Operations Research Society of South Africa (ORSSA) organises a student competition in two independent categories on an annual basis, namely an Honours or fourth-year level of study category, and a Masters level of study category. The prestigious Gerhard Geldenhuys Medal is awarded to the winner of the Honours or fourth-year category, while the prestigious Theodor Stewart Medal is awarded to the winner of the Masters category. The objectives of the competition are to propagate the use of Operations Research (OR) in higher education, encourage the inclusion of project work in OR courses, and to market ORSSA among students and staff at South African universities.
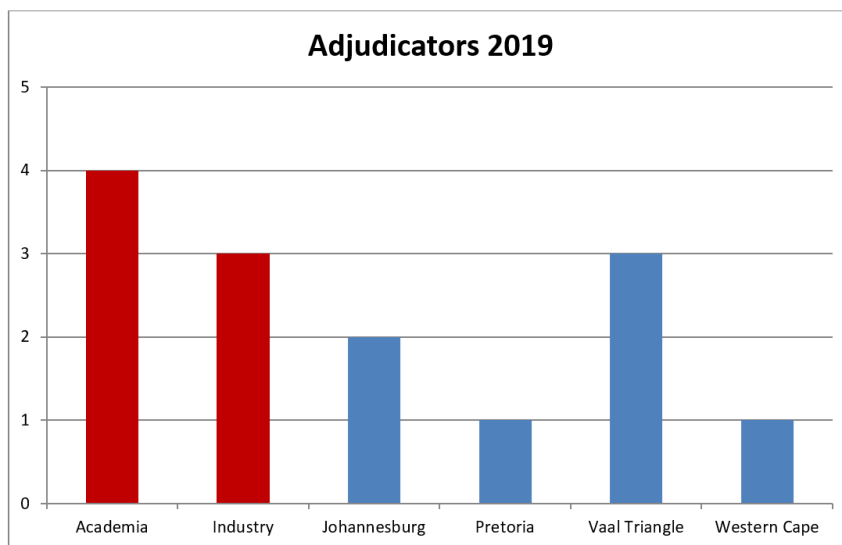
ORSSA student competition is congratulated in attracting nominations from more institutions than the previous year, but once again the following proposals are submitted to the Executive Committee of ORSSA for consideration:

- A department at an academic institution must be limited to two entries per category
- The coordinator of the ORSSA student competition is encouraged to continue taking additional effort to attract more nominations from more academic institutions in collaboration with chapter executive committees.

Adjudicators 2019

A breakdown of the sectors and provinces from which the judges of the student competition originate.

This year, supervising lecturers nominated nine written projects completed during 2018 by one Honours student from the Department of Decision Sciences at the University of South Africa as well as six fourth-year students from the Department of Industrial Engineering at Stellenbosch University, one student from the Faculty of Science at the University of Cape Town and one student from the Faculty of Economic and Management Sciences at Stellenbosch University. Supervising lecturers also nominated six theses completed during 2018 three Masters students from the Faculty of Engineering at Stellenbosch University, and two from the Faculty of Engineering at the North-West University, and one from Faculty of Science at the University of Cape Town. The coordinator of the

The convener of the nominations committee received nominations, after which he forwarded them to the convenor of the selection committee. The convener of the selection committee requested the assistance of three ORSSA adjudicators for the Honours or fourth-year category, and another four ORSSA adjudicators for the Masters category. Four of the adjudicators are from academic institutions and three are from industry, all with at least a Masters degree in a relevant field. The adjudicators are from the Johannesburg chapter (2), Pretoria chapter (1), Vaal Triangle chapter (3), and Western Cape chapter (1). Entries were ranked according to the rubric of criteria and quality descriptors as accepted by the ORSSA executive committee in March 2016. The adjudicators asked the convenor of the selection committee to pass on their congratulations to all the participants. All the projects are impressive, of the highest quality, most interesting and inspiring and

show clear understanding of fields of study, great attention to detail and care in their work with crisp conclusions. The writing is especially good for example the way literature studies are approached and explained and the adjudicators found it a rewarding process to read them. It was difficult to choose among the projects, further complicated by the wide range of problems and methodologies used, but in the end the finalists had a small edge over the others in that they went just a little bit deeper in their investigations and presented the results a bit more clearly and concisely. Both winners and runners up can be proud of their achievements.

The winner in the Honours or fourth-year category is Annika Brundyn with a project titled Mathematical Modelling Approach for Understanding the 2014 - 2016 Ebola Virus Outbreak in Sierra Leone and Liberia, presented in partial fulfilment of the requirements for the Honours degree at the Department of Statistics at University of Cape Town under supervision of Sheetal Silal.

The runner-up is Annelie Wessels with a project titled `n Diskrete gebeurtenis simulasiemodel van die pasientevloei by `n kliniek in die Wes-Kaap, also presented in partial fulfilment of the requirements for the degree of HonsBCom (Kwantitatiewe Bestuur) in the Faculty of Ekonomiese en Bestuurswetenskappe at Stellenbosch University under supervision of Linke Potgieter.

The winner in the Masters category is J van Niekerk with a thesis titled Mixed integer linear programming for unit commitment and load dispatch optimisation, in partial fulfilment of the requirements for the degree of Master of (Industrial) Engineering at the North-West University under the supervision of Fanie Terblanche.

The runner-up is Gerrit Nel with a thesis titled A hyperheuristic approach towards the training of artificial neural networks, in partial fulfilment of the requirements for the degree of Master of (Industrial) Engineering in the Faculty of Engineering at Stellenbosch University under supervision of Jan van Vuuren.

Please note that the selection committee decided on a winner solely based on the written work. The finalists were invited to present their work at the 2019 annual conference. The results were announced at the awards ceremony at the conference.

A deep appreciation goes to the adjudicators who have invested a lot of time and energy in assessing the submissions. Your participation and encouragement to our upcoming OR practitioners is important and inspiring. I also thank the ORSSA president, Danie Lötter, who has entrusted me with this enlightening opportunity.

Honours category runner-up, Annelie Wessels, with ORSSA president, Danie Lötter

Honours category winning supervisor, Sheetal Silal, receiving the Gerhard Geldenhuys medal from Proffessor Geldenhuys himself, on behalf of her student, Annika Brundyn.
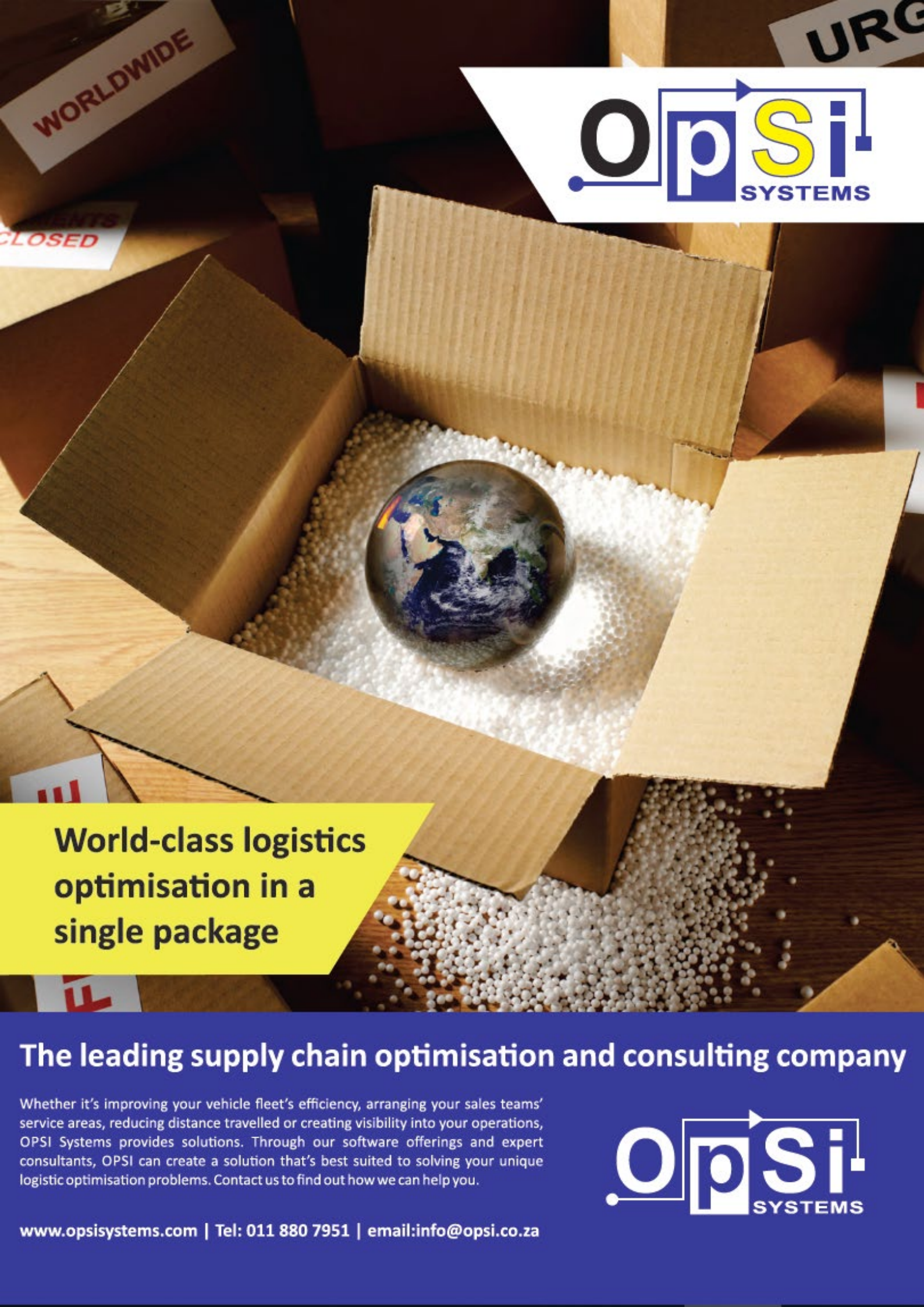

Masters category runner-up, Stephan Nel, with ORSSA president, Danie Lötter

Masters category winner, J van Niekerk, receiving the Theodor Stewart medal from Professor Stewart himself.

2019 ORSSA Recognition Awards

Each year, the Society makes recognition awards at its discretion to individuals who have served the profession of Operations Research in an exemplary fashion. These awards are considered a prestigious distinction and are reserved only for outstanding achievements and/or contributions. Awards may be made in four 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

- **Category IV:** To an upcoming member of ORSSA of age 35 or below (who is not a fulltime student) for excellence in OR practice

In addition, the Society may also invite long-standing full members to become Fellows of the Society. Individuals considered for this high distinction have typically served the profession of operations research and the Society in an exemplary manner for a considerable period of time.

The following awards were conferred at the 2019 ORSSA banquet event.

Category IV Award: Awarded to *Colin Phillips*
Citation by Angela Rademeyer (angelara@discovery.co.za)

Colin Andrew Phillips was born in Florida, West of Johannesburg. His childhood was spent in many different cities across SA due to his father working on the mines. He completed his matric at St Benedicts College in 2003. Colin then went on to study at WITS, completing a BSc in statistics & applied mathematics in 2006. He followed this with an Honours degree in operations research from the same institution the following year, winning the best honours project prize in mathematical sciences. In 2015 he achieved the Certified Analytics Professional (CAP) qualification from INFORMS.

He worked at OPSI Systems for 8 years in the consulting team, developing innovative solutions for optimization & simulation projects in the supply chain industry. Colin was also involved in data curation and visualization.

At OPSI, Colin worked on several projects in supply optimisation, and routing. He was responsible for projects for large companies in the creation of territories and routes for the sales people and delivery vehicles in many consultation projects. He was also the chief designer on two system. The first is a system for the creation of daily visit plans for sales people. The second is methodology for detecting stockout on supermarket shelves based on anomalies in daily sales history.

In 2017 he moved to Discovery to join the Data Science Lab where he has brought his energy, creativity, unconventional thinking and wit to the team. He is widely recognized at the company for his strong work ethic, mentoring of graduates and keenness to take on any task which would use science to make things better.

Colin Phillips receiving his award from ORSSA president, Danie Lötter.

Notable contributions include:

- using structured & unstructured data to model member journeys,
- improving recruitment practices for call centre agents,
- linear programming to optimize resource use for conservations,
- extensive work to assist the DSY research team who co-ordinate surveys,
- corporate member segmentation,
- team sizing for servicing new products,
- design of an operations data repository for advanced analytics and
- implementation & training to productionise models.

Colin has been responsible for rolling out best practices in analytical teams at Discovery, and continues to read widely to ensure the latest research techniques are applied where appropriate. Colin is proficient in R, Python, SAS, MAT-

LAB, SQL and Julia. He has presented papers at ORSSA conferences over the years and is a regular contributor at the lean coffee meetups in Johannesburg. Colin attended the Google Deep Learning Indaba in 2018 and has also participated in SatRDays. He also complete a 1-year advanced business course at Gibbs this year.

Colin is an incredible example of how versatile an operations researcher can be and has encouraged many others to study this discipline.

CATEGORY III AWARD: AWARDED TO *Christiaan Swanepoel*
Citation by Jan van Vuuren (vuuren@sun.ac.za)

Christiaan Jacobus Swanepoel was born in Stellenbosch on April 16th, 1962 and matriculated in 1980 at Vorentoe High School in Johannesburg. After obtaining a higher education diploma in 1984 and a BSc (Hons) degree in 1985, both from the then Rand Afrikaans University, he spent six years as a mathematics teacher in Johannesburg. While teaching on secondary school level, he obtained an MSc degree in mathematics cum laude from the University of Pretoria in 1989. The following year he moved into the tertiary education sector, accepting a position as Lecturer in the Department of Mathematics and Applied Mathematics at the University of Pretoria. He also enrolled for doctoral studies on a part-time basis and went on to obtain a doctorate in mathematics from the University of Pretoria in 1995, based on a thesis titled *Ramsey properties of trees and parameter words*. During that year he was also appointed as a Senior Lecturer in the then Department of Quantitative Management, now the Department of Decision Sciences, at the *University of South Africa* (Unisa).

He was promoted to Associate Professor in the same department in 1997 and served as deputy head of the department during the period 1997–1999. In 1999, he was promoted to Professor of Decision Sciences and took up the position of head of department, holding this position until 2010 when he was appointed as Acting Director of the School of Economic Sciences at Unisa. This position was made permanent in 2011, and Professor Swanepoel served as Director of the School of Economic Sciences until 2016 when he made a brief transition into university management at Unisa, first by accepting an appointment as Chief: Systems and Governance Support 2016 and then as Acting Deputy Registrar during the period 2017–2018. He returned to the Department of Decision Sciences to resume his teaching and research duties in May 2018.

The research interests of Professor Swanepoel span areas of combinatorial optimisation, structural Ramsey theory, digital typography and machine learning. He has himself published in these areas in reputable journals, such as *Graphs and Combinatorics* and *Discrete Mathematics*, as well as in the influential series *Lecture Notes in Computer Science*. In addition, he has also supervised a number of master's and doctoral students to the successful completion of their studies at Unisa. He is a Fellow of the Institute

Chris Swanepoel receiving his award from ORSSA president, Danie Lötter.

of Combinatorics and its Applications and is member of the *Suid-Afrikaanse Akademie vir Wetenskap en Kuns*.

Professor Swanepoel was nominated for this award because he has firmly supported the sustained inclusion of traditional operations research and the introduction of more recently emerged, related areas of study as fundamental tuition and research components within the Department of Decision Sciences at Unisa over his twelve-year tenure as head of department and also thereafter in an advisory capacity. He oversaw a major modernisation of the department's curriculum during the early 2000s during which module contents were updated significantly and new modules were introduced in areas such as linear programming, nonlinear optimisation, stochastic modelling, decision analysis, financial mathematics, forecasting, neural networks, simulation, mathematical modelling of derivatives, and discrete financial modelling.

He insists on defining operations research in the broadest possible terms and was instrumental in steering the Department of Decision Sciences towards excellence in diverse areas of research such as option pricing, optimisation under uncertainty, fuzzy sets and fuzzy optimisation, multi-objective programming with possibilistic coefficients, Brownian motion, complexity and computability, quantum computing, artificial neural networks, random graph theory, water and energy management, competition and vertical/agglomeration effects in mergers, and many more, by appointing the right people and creating a work-

ing environment in which research effort is encouraged and rewarded. And all this during a period of serious instability and uncertainty in South African higher education which saw a host of rationalisation mergers between tertiary institutions that were not all research-oriented and goal-aligned.

Professor Swanepoel remains a visionary force in the department. Just recently, for example, he had the vision to establish a Decision Laboratory in the department for laboratory-based research in the decision sciences aimed at developing analysis, planning and evaluation processes for complex management tasks in organisations, industry and government. The laboratory will focus on application areas in strategic planning, complex operational decision making and collaborative management.

Although not a member of ORSSA himself, Professor

Swanepoel appreciates the value that operations research is capable of adding to the skill sets and professional make-up of individuals tasked with sound decision making and decision support. In his capacity as head of the Department of Decision Sciences he facilitated the training and nurturing of a new generation of operations researchers and decision science consultants. Indeed, the Department of Decision Sciences is the leading department in the country in terms the number of operations research graduates produced annually on bachelor's and honours levels. The third-year and honours student numbers varied between fifty and about a hundred students per level in 2018.

For these contributions to the profession of operations research in South Africa over a significant period of time, Christiaan Jacobus Swanepoel is, on this 10th day of September 2019, duly awarded a Category III ORSSA Recognition Award.

The 2019 Tom Rozwadowski Medal

by Gemma Dawson (gemmadawson@gmail.com)

The society's premier award is the Tom Rozwadowski Medal and is awarded to a member of the society with the best written contribution to Operations Research in the previous year. Being first awarded in 1971, the list of honorees is a who's who of ORSSA and this year we added B Lindner, R Brits, and JF Bekker along with JF Van Vuuren earning his sixth medal.

The winning paper, titled *Tradeoffs between levelling the reserve margin and minimising production cost in generator maintenance scheduling for regulated power systems*, was published in Electrical Power and Energy Systems.

Determining a feasible schedule for the maintenance of power generating units is no easy feat and getting it wrong could have dire consequences for both the power utility and the consumers. Lindner and his co-authors proposed a bi-objective model for the generator Maintenance Scheduling problem when existing literature only offered single objective models. It was shown that making use of the multi-objective model's results could result in fuel cost savings and if further relaxations were made, these costs could increase dramatically.

Congratulations to the winners this year!

Abstract:
One of the key focus areas for a power utility is the planned preventative maintenance of the power generating units in its power system. The well-known *generator maintenance scheduling* (GMS) problem involves finding a schedule for

Prof Jan van Vuuren receiving the Tom Rozwadowski medal from ORSSA president, Danie Lötter, on behalf of the winning paper's authors which also included Dr Bernie Lindner and Prof James Bekker.

the planned maintenance outages of generating units in a power system. A novel bi-objective model is proposed for the GMS problem in which demand reliability is maximised, by minimising the *sum of squared reserves* (SSR), and electricity production cost (predominantly fuel cost) is minimised. A novel production planning module is proposed to estimate the production cost associated with an energy generation plan, using a *linear programming* (LP) model to solve the *economic dispatch* (ED) problem, which precedes application of a simple *unit commitment* (UC) algorithm. A dominance-based multi-objective simulated annealing approach is then adopted to determine trade-off solutions to the model. Parallel computing is also utilised to increase the efficiency of approximating the Pareto front. The modelling approach is demonstrated in the context of a case study involving the 32-unit IEEE Reliability Test System. The results are compared to the best known

single-objective solution in the literature, which only minimises the SSR, and the conflicting relationship between the two model objectives is investigated. It is found that more non-dominated trade-off solutions result if the load demand increases (*i.e.* the gap between installed capacity and load demand decreases). Therefore, if the installed capacity is sufficiently high, the reliability objective of minimising the SSR produces sufficiently small production cost solutions. Fuel cost savings of 0.41% are achieved in respect of a most "reliable" solution in the literature, but considerable cost savings are possible (up to 7.11%) if the maintenance duration and crew constraints are relaxed.

BOOK LAUNCH: OPERATIONS RESEARCH IN SOUTH AFRICA
THE FIRST 50 YEARS

by Hans Ittmann (hittmann01@gmail.com)

The Operations Research Society of South Africa (ORSSA) celebrated its 50th anniversary at its most recent annual conference held from 8 to 11 September 2019 in Cape Town. As part of these celebrations the society launch a book titled: Operations Research in South Africa – the first 50 years. The book records the history and activities of the society over five decades. In addition, it chronicles the history of operations research while several chapters are devoted to new and recent methodological developments of the discipline. (*As the author of this contribution is also a contributor to the book discussed here, this cannot be a book review but is just an outline of the book.*)

OR involvement by South Africans goes back many years. South African scientists were involved, as operations researchers, during World War II. After the war the first known operations research related work in South Africa, during the early fifties, was in the mining environment. There was one South African, RR Tusenius, amongst the delegates that attended the first international OR conference held in Oxford, the United Kingdom (UK), in 1957. However, it was only during the late sixties that a group of young enthusiasts started meeting informally to discuss interesting operations research topics. At a meeting held in April 1968, with guest speaker, the well-known UK operations researcher, Prof BHP (Pat) Rivett, a National Steering Committee was constituted with the aim of establishing an operations research society in South Africa. This happened on 21 November 1969 in Johannesburg during the first conference of the Operations Research Society of South Africa. The society, the first to be established on the African continent, has a proud history that is captured, comprehensively, in this new publication.

The book is structure in six main parts, each with several chapters or sections. A significant number of authors, all members or past members of ORSSA, contributed to various parts or sections of this voluminous book. Each chapter is independent of the rest of the chapters which allows a reader to read single chapters, or parts, without loss of contextual understanding. Over and above having a preface and a list of all the authors, with short biographies on each one at the beginning of the book, there is also a chapter 0 which gives an outline and description of what operations research is!

Part One is devoted to the birth and emergence of the multi-discipline of OR. Many developments, over centuries, can be attributed towards contributing to what became known as operations research. These are outlined and discussed in detail in chapter 1. Mathematical developments, in the chronological order that these occurred over time and how these contributed to OR, are presented, culminating in the period 1936 to 1945, the real birth of OR. The Post-War period is addressed in chapter 2 covering aspects such as the diffusion of OR into industries, academic research that was initiated to contribute to the development of this new discipline, the establishment of learned societies, the first OR conferences as well as the first OR related publications. The last chapter in Part One focusses on the early years of OR in South Africa before the founding of ORSSA.

The entire Part Two is devoted to activities of ORSSA. The establishment of the society is covered in chapter 4. Soon after the creation of ORSSA, several regional chapters, the real lifeblood of the society, were formed. There are currently six chapters, the last one being Zimbabwe, the neighbouring country, and this forms part of the outreach into Africa by ORSSA, one of its objectives. There is a chapter covering all the annual ORSSA conferences, currently 47 that were held over the 50-year period, as well as other related conferences. ORSSA was involved in organizing several international conferences including the 13th Multi-Criteria Decision Making (MCDM) conference in 1997, the 4th International Conference on Operations Research in Development (ICORD) in 2001 and the 18th International Federation of Operational Research Societies (IFORS) triennial conference which was held in Sandton in 2008. In 1985 ORSSA started publishing its own bi-annual journal with the name ORiON. Chapter 7 lists all the papers published in this journal while detail is provided on volumetric statistics, paper topics, the citation of papers together with a comprehensive analysis of the authorship of papers.

Four chapters in Part Two is dedicated to awards and recognitions bestowed by ORSSA. Annually a member of ORSSA receives the Tom Rozwadowski medal for the best journal article published in the preceding calendar year. The background to this prestigious medal, named after a founding member of the society, the winning papers and some interesting statistics concerning these papers are discussed in chapter 8. What is also mentioned in this chapter is international recognition the work ORSSA members received. Included in this is the work done by a team for the military that won the Franz Edelman award in 1996, the work of a team from the chemical company, Sasol, that were finalists in 2010 for the Franz Edelman award and a paper that won the Goodeve medal of the Operational Research Society of the UK in 1983. Chapters 9 to 11 contain detail, respectively, on all the Fellows of ORSSA, other Recognition awards winners (there are 4 different recognition categories) as well as the annual national student competition winners. In the latter case there are two different student competitions namely one for fourth year students and one for Masters' students. The last two chapters in this Part covers OR for Development and the effort of ORSSA to reach out to the rest of Africa.

In Part Three the OR landscape in South Africa is presented in four different chapters. There is a chapter on OR in the private and public sectors in South Africa, and one on OR in the military. Stellenbosch University was the first university to offer OR courses in South Africa. This happened in the early sixties. A separate chapter outlines what OR courses were offered by this university, how the courses offered changed over time, etc. and detail on OR students that graduated from this university. A further chapter in Part Three is devoted to OR teaching and research conducted at eight other universities in South Africa.

What makes this book a bit different is that it also includes trends in OR methodology. Topical areas in OR are presented giving an account of an areas' origin, the development thereof while significant aspects of each are highlighted. Part Four, with its seven chapters, thus focus on traditional and recent developments in OR. Chapters 18 and 19 describe Hard OR techniques and the emergence of Soft OR approaches respectively. In each of these two chapters the techniques are briefly outlined and described. The five subsequent chapters each cover one of the following topics: multi-criteria decision analysis and multi-objective optimisation; the rise of metaheuristics; computer simulation modelling; the coming of age of machine learning, and the age of big data and distributed computing.

In conclusion the last two chapters, that constitute Part Five, gives, respectively, a perspective of the current state of OR in South Africa while the last chapter is an attempted to indicate what the future holds for OR in South Africa.

Finally, Part Six contains several appendices with lists of all the ORSSA Presidents, Fellows and Honorary members, all the Executive Committees over the entire 50-year period, annual conference venues, recipients of the TR medal, recipients of recognition awards as well as the names of all the national student competition winners. There is also a timeline of Operations Research related events including OR events from elsewhere in the world.

Various books have been published on topics related to the history of OR. Operations Research in South Africa – the first 50 years is the first, or one of the first books, dedicated solely to the history of a national society. During the gala dinner at the 48th ORSSA conference this book was ceremoniously handed to the current ORSSA President by the two editors of the book. The South African OR society has a proud history. It is a vibrant and active society with many achievements. As a relatively small society, located on the most southern part of Africa, it has played a significant role in operations research in the country, the region and internationally.

Operations Research in South Africa – the first 50 years by Hennie A Kruger and Jan H van Vuuren (Editors), 2019, African SunMedia, Stellenbosch, pp. 1028, ISBN 978-0-620-84721-6 (Print)

For those interested in ordering a copy of the book please contact Christa de Kock at christadk@sun.ac.za She has volunteered to handle any orders and will have the books sent to anyone that would like to buy a copy of the book. The price of the book is R 750 plus postage.

Editors Prof Jan van Vuuren and Prof Hennie Kruger officially launch the book *Operations Research in South Africa - the first 50 years* at the conference banquet with ORSSA president, Danie Lötter.

OPERATIONS RESEARCH IN SOUTH AFRICA

The First 50 Years

Edited by HA Kruger & JH van Vuuren

OPERATIONS RESEARCH IN SOUTH AFRICA   HA Kruger & JH van Vuuren

This volume contains a concise history of operations research in South Africa from its local inception during the late 1950s until 2018. It is both a comprehensive record of the activities of the Operations Research Society of South Africa during its first fifty years of existence and a compendium of operations research as practised locally in the public, private and tertiary education sectors.

About the Editors

Hennie A Kruger was born in Bothaville, South Africa. He obtained master's degrees in information systems (from the University of the Orange Free State, in 1989), in mathematical statistics (from the same university, in 1999) and in philosophy (from North-West University, in 2015). He also holds a doctorate in information systems from the Potchefstroom University for Christian Higher Education (obtained in 1994). He worked in the information technology industry for more than twenty years and has been a member of staff at the then Potchefstroom University for Christian Higher Education (now North-West University) since 1999, where he is currently Professor of Computer Science and Information Systems. He is the author of various journal and peer-reviewed conference proceeding papers and has supervised a number of postgraduate students in areas of operations research and information security. His research interests include decision support systems and the human aspects of information security. He is a Fellow of the Operations Research Society of South Africa.

Jan H van Vuuren was born in Durban, South Africa. He obtained a master's degree in applied mathematics from Stellenbosch University in 1992 and a doctorate in mathematics from the University of Oxford, United Kingdom, in 1995. He has been a member of staff at Stellenbosch University since 1996, first in its Department of Applied Mathematics (1996-2007), and then in its Department of Logistics (2007-2013). He is currently Professor of Operations Research and Head of the *Stellenbosch Unit for Operations Research in Engineering* (SUnORE) within the Department of Industrial Engineering at Stellenbosch University. He is the author of a large number of journal and peer-reviewed conference proceeding papers. He has also supervised many postgraduate students to the successful completion of their studies in areas of operations research. His research interests include graph theory, combinatorial optimisation and decision support systems. He is a Fellow of the Operations Research Society of South Africa.

Typeset by

Anton P de Villiers was born in Cape Town, South Africa. He obtained a doctorate in operations research from Stellenbosch University in 2014 on a topic in secure graph domination. Upon completion of his studies, Anton worked with a number of start-up ventures in Cape Town before relocating to Düsseldorf, Germany in 2018 where he is currently working at McKinsey & Company as a Senior Fellow, Data Scientist focusing on optimisation problems in the travel, transport and logistics sector. He is also an extraordinary senior lecturer in the Department of Industrial Engineering at Stellenbosch University. He is the author of various journal publications on topics in graph theory and distribution centre optimisation.