



*AT THE FOREFRONT OF ANALYTICS IN AFRICA*



**ORSSA Newsletter March 2019**

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# ORSSA 2019

48TH ANNUAL CONFERENCE

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SEPTEMBER 2019**

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**WITH KEYNOTE SPEAKERS**

**CONFERENCE TUTORIAL BY**



Prof. M Grazia Speranza



Prof. Gerhard Geldenhuys



Prof. Erwin Pesch

## IMPORTANT DATES

**1 MARCH 2019**

**20 MAY 2019**

**31 JULY 2019**

**16 AUGUST 2019**

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SUBMISSIONS FOR PROCEEDINGS CLOSE

SUBMISSIONS FOR PRESENTATION ABSTRACTS CLOSE

REGISTRATION CLOSES

**EXCITING SPONSORSHIP OPPORTUNITIES AVAILABLE!**

**FROM THE EDITOR**

By *BRIAN VAN VUUREN*  
(*brianjohnvanvuuren@gmail.com*)



Brian van Vuuren

Dear ORSSA Community,

We're already a quarter way into the year and with that comes the first edition of the newsletter for 2019. This one was a tough one to put together as the busyness of work, combined with 'slim pickings' in terms of content, made it a challenge to gather contributions and format a meaningful document.

That said, in the end, some regular stalwarts pulled through and I believe we've ended up with quite an interesting edition. A big thank you must go to Rob Bennetto who, in spite of his crazy schedule being CTO at IcePack, found the time to contribute what I feel is the 'heart' of this March edition – a fantastic interview with Luis Gouveia (*the head of the program committee of the EURO 2019 conference due to take place in Dublin later this year*). The interview went through several iterations to ensure Luis felt well represented and Rob's consistent patience and effort to get the piece of writing out is hugely appreciated by me as the editor – thanks Robbie-B!

Even further, Rob's interview has given way to a new column which, we hope, will be featured regularly in the newsletter, called 'Coffee & Pi - A relaxed approximation of conversations with interesting people one has the good fortune of meeting'. Although Rob's brainchild, the column is intended as a platform for any ORSSA member to contribute an interview with an interesting figure in the OR community whom they may come accross. I encourage you to keep this in mind in the event that any prestigious researchers or practitioners visit your university or business in time to come.

We also have a great book review by Hans Ittmann who never fails to so kindly contribute to our newsletters. Thank you, Hans, for always being willing to let us feature your detailed, insightful book reviews which no doubt take a fair chunk of time to craft. I appreciate it very much. It's also great to have a piece from our Zimbabwe chapter chair, Philimon Nyamugare (assisted by Bernie Lindner) sharing some details and plans for the Zimbabwe chapter which now falls resides ORSSA's wing.

I'm also grateful to my friends who studied at Stellenbosch University with me, Jancke, Mattie and Pieter, who I could call on to contribute updates as to what they are up to in their academic and professional lives.

I've often heard that the newsletter is 'too Stellenbosch focused'. This stands to reason, since coming from Stellen-

bosch myself, these folks are my go to network (meaning I can pressure them into contributing content for the newsletter). I've tried to mitigate this Stellenbosch-focus by profiling different chapters in the ORSSA community, but I fear this has only led to Chapter Chairs and Exec Committee members being forced to write articles themselves to compose these feature editions.

In any event – the newsletter is meant to be an interesting and engaging read which profiles the activities, interests and contributions of the entire society. I say it every edition and I'll emphasize it again – contributions from anyone and of any nature are welcomed! Consider yourself *pressured* by me to contribute something – what you're up to, what you're studying, where you're working or what you're interested in. Please consider putting together something small for a future edition. My dream is to be so backdated with content that we have to have a waiting list to be featured in newsletters to come!

I hope you enjoy this March edition of the newsletter - please feel free to let me know what you think (*and that you actually read it!*). I appreciate any and all feedback from the people for whom this newsletter is compiled.

All the best,  
Brian



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## FROM THE PRESIDENT'S DESK

By DANIE LÖTTER

(DANIEL@OOSLOT.CO.ZA)

### ORSSA PRESIDENT



Danie Lötter

Warm autumn greetings to all ORSSA members!

As I am writing this, the end of the first term of 2019 is approaching fast and I cannot believe that the recent 2018 holiday spirit is merely a vague memory. I would, nevertheless, like to wish each member of ORSSA a very prosperous and productive year ahead. First, I would like to extend my sincerest gratitude to the 2018 Executive Committee (EC) for the sterling job they did in ensuring that the Society ran smoothly in 2018. The success of the Society relies heavily on the EC and without their hard work, achieving the goals of the Society seems almost impossible. Members serving on the EC do so voluntarily (*i.e.* not receiving any remuneration whatsoever) implying that these members sacrifice their valuable time in their personal capacity to the benefit of the Society. In light of this, I wish to thank each and every member who served on the EC for their hard work and dedication in manning their portfolios in such a way to upkeep the professional stature associated with OR and also with ORSSA, despite ongoing pressures posed by their normal working and personal activities. It is much appreciated!

Unfortunately, some of our EC members had to resign at the end of 2018. Thank you for your willingness to serve the Society in this exemplary manner and thank you each for the unique contribution that you made towards the Society. I would then like to welcome the newly appointed members of the 2019 EC who can be found on page 3 of this Newsletter. I am really looking forward to working closely with a dedicated team to serve the Society and to ensure that ORSSA remains the professional OR home for South African and Zimbabwean OR practitioners.

I shall be relying on each one of you to achieve the Society's goals for 2019.

This year marks the 50<sup>th</sup> birthday of ORSSA which the Society shall celebrate as a whole at the 48<sup>th</sup> annual ORSSA conference which is taking place at the prestigious Vineyard hotel situated on the Eastern slopes of Table Mountain in the Southern Suburbs of Cape Town. This year the conference is organised by the Western Cape chapter and promises to be, once again, a very memorable event. I am very excited to be sharing in the celebration of this milestone with the Society in September. Please try your best to attend this highlight of the Society's annual calendar. The conference always affords vast opportunities on many levels to members and brings together communities from industry and the academic sector to network and to share their work orally.

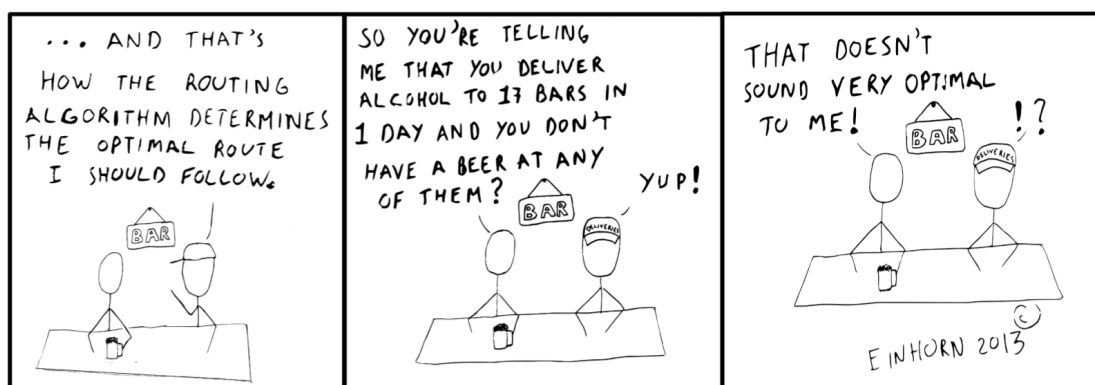
Members should also be receiving their invoices for membership dues shortly. I would like to urge all members to pay their membership dues timeously. Any questions or queries with respect to your statement may be addressed to the national treasurer who may be contacted via electronic mail on [treasurer@orssa.org.za](mailto:treasurer@orssa.org.za)

I would like to close by urging members of the Society to also embrace the opportunities which the Society offers them. Make an effort to attend the chapter events organized by your chapter chairs – these are excellent opportunities to network with other members in your surrounding OR community and to share ideas outside your normal work environment.

Finally, feel free to contribute to the Newsletter (on a less academic level) and the Society's official academic journal ORiON (on a more scientific level). Both these publications are great communication vehicles to showcase your work to members of the Society.

With my best wishes,  
Daniel Lötter

### One from the ORSSA archives...



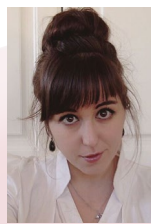
## THE 2019 ORSSA EXECUTIVE COMMITTEE



**President:**  
Danie Lötter



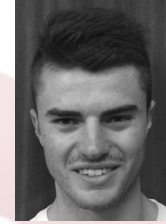
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**Newsletter Editor:**  
Brian van Vuuren



**Newsletter Business  
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Bernie Lindner



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Patrick Reynolds

### Additional Elected Members



Stephan Visagie



Christa de Kock



Joke Bührmann



Winnie Pelser

### Chapter Chairs



**Johannesburg:**  
David Clark



**Pretoria:**  
Marc Gagiano



**Vaal Triangle:**  
Philip Venter



**Western Cape:**  
Kit Searle



**Kwazulu-Natal:**  
Vacant



**Zimbabwe:**  
Philimon Nyamugare

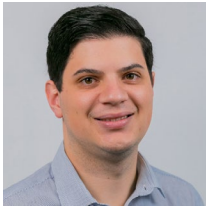
### Co-opted External Liaison Representatives



**IFORS Representative:**  
Hans Ittmann



**EURO Representative:**  
Theo Stewart

**GETTING TO KNOW O(U)R MEMBERS***Written by Jancke Eygelaar (jeygelaar92@gmail.com)***Jancke Eygelaar**

After finishing secondary school at Paul Roos Gymnasium, Jancke Eygelaar went on to pursue a degree in Industrial Engineering at Stellenbosch University. It is only until his final year when he was made aware of ORSSA, after his supervisor for his final year project, Professor Jan van Vuuren, an ORSSA fellow, introduced him to the society. His final year project involved clustering retail outlets based on their energy consumption for a large South African retailer. The clustering model took into account the location, floor size and sales quantity of an outlet and, based on these characteristics, provides clusters within which certain outlets reside and a prediction can be made regarding their expected energy consumption. This model may then be employed for planning purposes of new outlets as well as to identify outlets with unusually high energy consumptions based in the three characteristics.

After finishing his undergraduate degree in 2014, Jancke enrolled for a Master's degree in Industrial Engineering under the supervision of Prof. Jan van Vuuren and Dr. Danie Lotter. The work conducted in his research involved maintenance scheduling of power generation units for power utilities. The research took a new approach to solving this scheduling problem by taking into account the reliability of the power generating units. The objective function of the model was developed such that maintenance priority was given to both power generating units with the highest probability of failure and power generating units that contribute a large proportion to the overall capacity of the system. In 2017, he was nominated as a finalist in ORSSA's national student competition in the Master's category.

During this year, he was also awarded the opportunity to

upgrade his Master's thesis to a PhD which he accepted and obtained early in 2018.

**Jancke graduating with his PhD in Industrial Engineering at Stellenbosch University in early 2018.**

After obtaining his PhD, Jancke relocated to Johannesburg where he started his career at Decision Inc., a management and technology consulting company, as a Business Intelligence Consultant as part of the Advanced Analytics team. During his time at Decision Inc, he consulted for a number of companies with the majority of time being spent consulting for Massmart as a Business Intelligence Developer. During his time there he developed, improved and automated a number of internal processes, mainly in finance. Some of his focus was also placed on developing and refining some of the analytical capabilities of Decision Inc., enabling the company to better sell the idea of Advanced Analytics to potential clients with some practical use cases.

Jancke recently moved back to Cape Town where he started a new job at Truworths as a Business Intelligence / Data Warehouse Developer in the Business Intelligence team.

**WHAT O(U)R MEMBERS ARE UP TO***Written by Mattie Landman (mattielandman@gmail.com)***Mattie Landman**

*One of ORSSA's student members recently started reading for a DPhil at the Mathematical Institute at Oxford University. We asked her to share a brief account of how her journey across the pond came about.*

I was drawn to Industrial Engineering, after school, due to my interest in problem solving, mathematics, and social and economic systems. After completing a B.Eng. in Industrial engineering, I en-

rolled for a masters degree at the Stellenbosch Unit for Operations Research and Engineering, under the supervision of Prof JH van Vuuren. The topic of my masters thesis lay in the intersection of game theory and graph theory where we investigated the evolution of the classical prisoners dilemma on various graph topologies.

It was during this time that I was first exposed to the field of graph theory, and its use in understanding how complex systems of interacting agents evolve over time. Toward the end of my time at Stellenbosch, a fellow ORSSA member

at Oxford introduced me to Dr Neave O'Clery, whose research interests closely matched my own. The group for the Mathematics of Urban Sciences for Development conducts research aimed at Urban and Economic Policy formation. This is underpinned by network science to extract actionable insights from large and noisy datasets.

The aim of my DPhil thesis is to investigate knowledge and skill flow within the South African economy. Through analyzing the flow of workers between different industries in South Africa, skill-related industry clusters can be identified. The size and connectedness of these clusters within the economy provides useful insights on knowledge spillovers between and within clusters, as well as the vulnerability of various industries to economic shocks. This approach also allows for the identification of skill-shortages and transition paths between the informal and formal sectors.

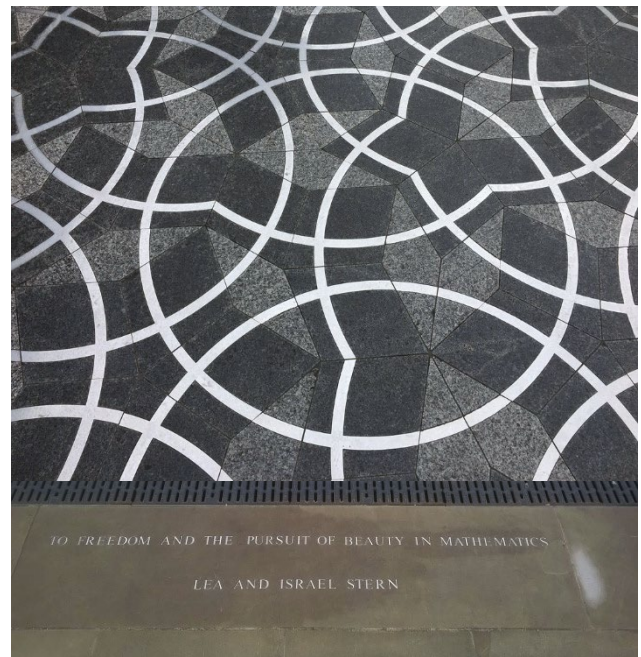
Since arriving in Oxford in September last year, I have settled in and I am thoroughly enjoying college life. Oxford is a beautiful city and the exposure to a diversity of



Mattie after her matriculation ceremony on entering the University of Oxford.

scholars and visiting alumni has been culturally enriching. The transition from Engineering to Mathematics has been challenging yet stimulating.

There are several sources of funding available for South Africans who wish to study at International Institutions. My research is funded by the Skye Foundation, Oppenheimer Trust and the Oxford Mathematical Institute.



The Oxford Mathematical Institute with its well-known Penrose tiling. What makes these tiles so special is that they are necessarily non-periodic (*i.e.* it is not possible to create the tiling by taking some section and repeating it over and over again).

## WHAT O(U)R MEMBERS ARE UP TO

Written by Pieter de Wet ([pdewet@businessmodelling.com](mailto:pdewet@businessmodelling.com))



Pieter de Wet

Pieter de Wet has been a member of ORSSA since 2014, first being introduced to the society while doing his Honours in Operations Research through the Department of Logistics at Stellenbosch University.

He then continued with a Masters in Operations Research, also working on one of the infamous

*Eldana saccharina* projects, more specifically looking at improving the spatio-temporal planning of sugarcane planting and harvesting and the effects it could have on the spreading of the *Eldana* pest.

In 2017, he made the move to Johannesburg and tackled the working world, where he joined Business Modelling Associates (BMA), a leading supply chain analytics consulting company. Here he has had plenty of exposure to us-

ing OR techniques to solve real world problems, spanning multiple industries.

During his first year at BMA he was tasked with improving forecast accuracy for a client, resulting in him creating a bespoke methodology and outperforming the forecasting software then in use by the client. Some of his other interesting projects to date have included the use of mixed-integer programming for end-to-end network optimisation

of the cash supply chain for a large South African bank, as well as an end-to-end supply chain solution for a forestry company, including all decisions from when a tree is harvested to the final product that is produced.

He is excited to learn more and grow in his ability to apply OR related techniques to real world problems and is enjoying the challenges and wide range of applications that comes with working in the analytics consulting space.

# What are YOU up to?

As an ORSSA community, we rarely get to connect and catch up with those outside of our chapters other than at our local conference. Even then – not everyone can always attend these gatherings.

Please consider getting in touch and letting the community know what you've been up to since we last touched base. This is especially applicable to students who joined ORSSA whilst completing their studies, but have since moved on to interesting, diverse careers. We would love to hear about what you are doing and how, if at all, Operations Research forms part of your career.

Anyone is welcome to submit a short piece on what you've been up to or what you're working on. If you'd be interested in a short feature, please contact the editor at [brianjohnvanvuuren@gmail.com](mailto:brianjohnvanvuuren@gmail.com)



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## COFFEE & PI

*A relaxed approximation of conversations with interesting people  
one has the good fortune of meeting*

The very first Pi & Coffee feature comes from **Robert Bennetto (robert.bennetto.za@gmail.com)** is with **Luis Gouveia**.

I had the pleasure of of chatting to Luis at the 8<sup>th</sup> edition of the Winter School in Network Optimisation held in Portugal earlier this year. Luis has successfully organised the winter school for the past 8 years – an event I would highly recommend for anyone doing post graduate study in Mathematical Optimisation.

Luis was the head of the department of Statistics and OR at the faculty of Sciences of the University of Lisbon from November 2012 to March 2018. If you're planning on attending the EURO conference this year in Dublin I would encourage you to grab a coffee (*or a Guinness*) with Luis – he is the Chair of the Program Committee of the Conference and thus, will definitely be there!

His pursuit for newness in the field of operations research was and is often scuttled by his responsibilities as former President of the Department. With his vast tracts of “free time” he is now also coordinating a center of Mathematics, Fundamental Applications and OR where most of the mathematics being done is pure mathematics

**What have you learned now that you wish the young version of yourself could have known in advance?**

Are you sure you don't want to wait for a few drinks before asking me that?

I was born in Mozambique, more precisely in Maputo – named “Lourenço Marques” at that time. I was just 17 years old when I arrived in Lisbon – Portugal. Despite having some family members here, it was a tough transition for several reasons: my father had passed away in the previous year we were in Mozambique (from illness) and we quickly realised that here we had fewer resources than before. I had left good friends in LM, where the city was smaller and we could meet for coffee or dinner often. In

Lisbon everything was further apart than I was used to and it was difficult to meet my trusted companions since we were living in neighborhoods of Lisbon that were far apart. Some of my friends that also left Mozambique went to other countries such as South Africa, Rhodesia and Canada, as far as I remember.

I faced my first Portuguese Winter. The winter here in Portugal might be attractive to many Northern European residents but for someone from Africa, it added a level of discomfort I was not used to.

I studied Statistics and OR because my brother in law, that came a few months earlier to Portugal, had enrolled me in it. Apparently he thought I liked applied mathematics – perhaps he was right. I started my first school year and began to make friends within the faculty. I was an average-to-good (but definitely not excellent) student in the first two years, but then I managed an excellent mark in a course in complex analysis, and began to think, “mathematics is something I could study further”. After graduating, I started out my career as an assistant in informatics but moved to OR shortly thereafter. The funny thing is, now all these years later, I can't say I was one of those people who knew they wanted to be a Doctor or a Mathematician growing up. I don't think my life is worth making a movie about but it certainly exceeded my early expectations.

I derive the most joy from helping students finding their own paths and guiding them. I guess to answer your question in short, I would tell my younger self that you'll find your peers, you'll find work you can excel at and one day you'll even be in a position to help set young people on a path to knowledge. It might even get better.

**Was there a defining moment for you when you realised operations research was going to be your area of applied mathematics?**

It was by chance. I entered academic life in a Computer Science Department and for some years I taught disciplines

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related to informatics and computer science and even did something equivalent to a Master's in "Petri Nets".

Then, for the PhD I changed to OR and I have to thank my advisor (his name is José Pinto Paixão) for accepting me and who, by the way, was the main person responsible for creating the OR group in my Faculty (and later he even became a director of the Faculty). Then, after my PhD I understood that I was going to stay in Academia, I started to publish and one thing led to another.

As a side comment, my start in Computer Science has helped provide the basis of my knowledge in complexity theory allowing me to understand a little bit about why some problems are more difficult than others.

**What advice do you give to students that you feel is sometimes not taken seriously enough? (Or perhaps only taken seriously when it's too late?)**

You are making me answer tough questions today! My students are not perfect, it's difficult to answer because I have students with so many different qualities and abilities.

I don't usually experience problems with students. I have supervised about 10 PhD students. I have found that the gifted students, the ones who find the concepts come easily to them, are sometimes guilty of doing less work. They have very good ideas but don't do the base work to fully understand what exists. They like to create but they don't always embrace spending time on researching what exists. For example, I'll suggest "let's do this section on a particular method" and then when you ask them to write the introduction – they ask me "what kind of paper should I read?" and I have to wonder, why they haven't done more research and read every paper they can find on the topic?

Conversely, sometimes the students who struggle more know the literature very well, but don't have that ability to create. I am happy to report that these are all examples that turned out well in the end.

**Are there any problems in discrete mathematics that are solved/unsolved that really stand out for you as being really special?**

I would like to see a nicer proof for a 4-color theorem. There is a proof that is made by examining a huge subset of configurations – and I'm not against using the computer as it was done for this proof - but I would like to see a tidier proof closer to the min-max proofs of many combinatorial problems.

**Is there a particular paper that read and thought "Wow – that was insightful"?**

A long time ago I read a paper on the two level network design problem by Balakrishnan, Magnanti and Mirchandani (one of the BMM papers). One of the great parts on the paper was a discussion about the strength (in terms of LPs) of directed versus undirected formulations. I read the paper and I thought, "I would like to do one like this myself."

In fact, this discussion between directed versus undirected formulation might have had a role on what I did afterwards. I saw a very nice talk by Tom Magnanti about directed cut versus undirected cut constraints (something that is folklore nowadays) but at that time was not yet understood, at least to many of us. I liked the way Tom posed the discussion, like a mystery and in such a way that immediately piqued peoples' interest in the topic.

One of my great pleasures, is that later on I was able to do a Pós-Doc with him (that is, I had the pleasure that he accepted to have me doing the Pós-Doc with him) at MIT. He was the director of the OR center at MIT for a long time. We were able to combine "simple" insights from graph theory combined with ILP reformulation techniques that lead to improvements on exact methods for a particular network design problem. I guess this collaboration (and the papers that result from it), opened many doors for me thereafter.

But most of all, it has been a pleasure to have worked with someone so pleasant and which is able to contribute to your own knowledge.

**If you could have dinner with any researcher from any year, who would it be?**

I am not "attracted" to that idea that I should try to imagine working with a big name from the past. It is not lack of imagination. The reason why, is that I believe that nowadays there are very good researchers, alive, some of them not (yet) well known.

I could think easily about a few names that I would like to have dinner with.

However, and as a follow up to the answer of the previous question, it would be great to have an opportunity to sit across a table from Tom again.

I continued working with him, for some years after my Pós-Doc year, when he was already the Dean of the School of Engineering and I even remember visiting him in August on my school holidays (to use this extra time to continue working together).

It's a pity that I have lost contact with him over the years. He was a brilliant example to me in terms of a researcher, in his style and how he interacted with people - he always

treated people well and I respected that and have tried to continue on that path with my own research.

## Is there a particular paper in your mind that really stands out as Iconic?

Probably not my best papers but there were two twin papers that were relevant, at least in part of my life. These papers describe a projection result relating a set of constraints, the so-called “multistar” constraints, to a specific flow based model. This relation was first proposed for a telecommunications related problem. One of Tom’ students really liked it, and it probably helped to facilitate the process of doing my Post-Doc at MIT. The result was later extended to a vehicle routing problem, which gave some impact on the area of routing.

Many people associate me with network design and hop constraints as I have a few papers on this topic. When I first started working on this I thought this is a constraint that makes sense to consider in telecommunications network design but I had not seen an application yet. The constraints on the network made sense to me when thinking about the Metro in rush hour. It sometimes makes sense to take a longer path, but through less intermediate nodes.

A validating proud moment;

Later, a telecommunications engineer from the University of Aveiro, Amaro de Sousa, (who I would later collaborate with on papers and projects) said that he thought my work was interesting and applicable, it was so validating. Not as big a moment as being invited to be the chair of the EURO Conference, but a proud moment for me none the less.

## Are there any recent collaborations you’re excited about?

Yes, most definitely! A few years ago, Ivana Ljubic (from Vienna – now in Paris) invited me to visit her; this initiated a long series of collaborations with her, which lead to collaborations with people related to her, such as Mario Ruthmair and Markus Leitner. This is the same Markus who lectured earlier today at the Winter School<sup>1</sup>.

One paper of mine with Mario, reports on instances solved for the first time for the Precedence Constrained TSP – which is very exciting for us. I also have an interesting paper alone with Markus who is among the most brilliant people I have had the pleasure of working with.

<sup>1</sup> Luis pointed at Markus who was sitting behind me. We had enjoyed a thorough treatment of layered graph modeling approaches earlier in the day and I suspect he was front of mind for Luis during this conversation. Markus was waiting patiently to steal Luis away to continue work on one of their papers.

These collaborations have been incredibly enlightening and rewarding for me, reminiscent of my time spent with Tom in my early career. While some of these recent collaborations aren’t household names yet – I suspect one day they might become exactly that. This is not to diminish the significance of my other collaborations – simply what comes to mind looking around the room.

## Speaking of the folks in the room, have you already determined the line up for the next Winter School?

Yes, I do have the line up for winter school 9 and 10 – and no I’m not going to tell you! However, I can say that we are thinking of starting to invite teachers that were here as students in former schools (one of them is included in the aforementioned line up). Together with my colleagues we are excited to be able to present on and deliver 10 years of winter schools on network optimisation, something which may not have been possible without the support from individuals such as Bernard Fortz<sup>2</sup> and the European Network Optimisation Group (ENOG). I think people are happy with what we’ve done with the school, and we are looking forward to another great year of growth and to welcoming you back to Portugal.



The participants of the Winter School in Network Optimisation held in Portugal

<sup>2</sup> Luis pointed out Bernard who was also in the room at the time.

*‘Coffee & Pi’ is an initiative started by Rob Benetto and is intended to be a platform for ORSSA members to share their conversations, interviews and interactions with interesting people they meet within the Operations Research community.*

*Please feel free to contribute an interview to this column in the event that you are fortunate enough to meet someone interesting or prominent who is willing to sit down with you for a chat.*

## OPERATIONS RESEARCH IN ZIMBABWE

*Written by Philimon Nyamugure (pnyamugure@gmail.com) & Berndt Lindner (berndtlindner@gmail.com)*



**Philimon Nyamugare**

Operations Research (OR), was introduced in Zimbabwe in the early 1970s with elective courses offered under engineering and statistics degree programmes at what was then the University of Rhodesia. Although not called “operations research” during those years, courses such as systems engineering, optimization, decision theory, and mathematical programming were found in several relevant degree programs (Evans *et al.*, 2011). In 2005, in response to recommendations from industry and commerce, the then Department of Applied Mathematics at the National University of Science and Technology (NUST) introduced a four-year Bachelor of Science Honours Degree in Operations Research and Statistics. This increased the use of OR in different industry sectors in Zimbabwe and hence the demand of graduates with the qualification. With the increased demand for Operations Research graduates in the country, the University introduced the Department of Operations Research and Statistics in 2012 which has grown tremendously and now plays host to regional students seeking the degree. Going forward, the Department now intends to introduce a degree programme in Operations Research as a stand-alone degree program (without the Statistics component), hopefully by September 2019. Having a stand-alone degree in Operations Research will enable the Department to offer more courses in Operations Research which are currently in demand in the industry. The programme will also provide opportunities for students from different academic backgrounds (sciences, commerce and arts) to broaden and apply scientific methods to improve the effectiveness of operations, mathematical skills for quantitative analysis, decision making, and management. So far the department has had students from almost all the Southern African Development Community (SADC) countries as well as from South Sudan.

In 2007 NUST Operations Research Society (NORS) was formed with the aim of spreading the gospel of OR across the whole country. NORS also on an annual basis exhibits its programmes and activities on the annual Zimbabwe Trade Fair, an exhibition that attracts foreign and local companies. Plans to form Zimbabwe Operations Research Society (ZORS) have been suggested and are being considered. Since NUST is the epicentre of OR in Zimbabwe, four local universities are now offering OR programs. In 2010 the majority of the members have suggested that we apply to Operations Research Society of South Africa (ORSSA) to become a Chapter. A lot of experience can be learnt before the introduction of ZORS.

In November 2016 Berndt Lindner an executive member of ORSSA visited NUST and gave a talk on ORSSA, and the formation of the African Federation of Operations Research Societies (AFROS). He emphasised the need for co-operation between African countries in making sure that OR grows in Africa. He was keen to see Zimbabwe become a chapter of ORSSA in an effort to eventually form a National OR society, an idea that was being explored already by the Zimbabwean OR community at NUST.



**Berndt Lindner**

In 2017 NORS applied to ORSSA for Zimbabwe to be considered as a chapter of ORSSA. A local committee was elected comprising of the following members:

Chairperson	Mr. P. Nyamugure
Vice Chairperson	Mr H Nare
Secretary General	Mr. C N Mupondo
Treasurer	Mrs. I. L Moyo
Committee Member	-
Phone	+263 775896565
Fax	00263 9 286803
Email	pnyamugure@gmail.com or philimon.nyamugure@nust.ac.zw
Contact Person:	Mr. P. Nyamugure <i>Faculty of Applied Sciences</i> Department of Statistics and Operations Research National University of Science and Technology Box AC 939 Ascot Bulawayo Zimbabwe

So far, the chapter has held its first meeting on the 17th March 2017. In the meeting it was agreed that we need to market the chapter to students across the country. It was also agreed that we need to market the Chapter to industry across the country with the hope of creating Memorandum of Understanding (MoU) with industry.

In 2017 the chapter had an interest from around 70 individuals, consisting of 12 Lecturers, 8 executives from different industries, and around 50 students. Converting all these 70 interested individuals to registered ORSSA members is proving to be a challenge due to obtaining the for-

eign currency in Zimbabwe required for the applications.

## Activities

- Facilitating the industrial attachment/ internship of students into industry
- The Chapter also helps in identifying the companies that need students for industrial attachment.
- Collaborative research where members, especially lecturers working with companies in identifying problems and looking for solutions to solve these problems. Industries provides the vital data that is used in coming up with the solutions.
- Community awareness activities to help communities

realise that they can apply simple OR techniques to solve some of the problems they are facing.

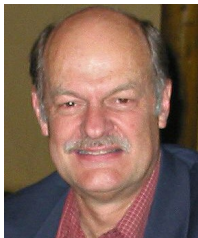
The Zimbabwean chapter managed to set up a desk during the 2018 NUST club expo to explain to members of the public what the Chapter is all about. A workshop on the best ways to utilise Operations Research in the community is being planned for mid July 2018.

## Reference

Dave Evans, 'Maseka Lesaoana, Philimon Nyamugure and Caston Sigauke (2011). Operations Research roots run deep in Southern Africa: *Institute for Operations Research and the Management Sciences (INFORMS)*, 32(2).

## BOOK REVIEW: INFORMS ANALYTICS BODY OF KNOWLEDGE

Written by Hans W. Ittmann ([hittmann01@gmail.com](mailto:hittmann01@gmail.com))



The book *INFORMS Analytics Body of Knowledge* (INFORMS ABOK) was published recently and is a welcome addition to the growing analytics literature. The title is fascinating in the sense that many readers would want to know what is meant by a body of knowledge.

Hans Ittmann The editor clarifies what it is in the start of the preface: “A *body of knowledge (BOK)* is a *comprehensive compilation of the core concepts and skills with which a professional in a specific discipline should be familiar. BOKs are generally produced and maintained by members of an academic society or professional association, and a BOK serves as the means by which the academic society or professional association communicates its vision, both internally and externally.*”

The Institute for Operations Research and the Management Sciences (INFORMS) in the United States, the largest international association of operations research (OR) and analytics professionals and students, produced the book. There are nine chapters in the book covering a wide spectrum of topics on analytics. Each chapter is written by a different author, except in one instance where an author of one chapter is also the co-author of another chapter. The authors are some of the most respected members of INFORMS, all experts on the various topics covered and all from prominent institutions. There is an appendix titled *Writing and Teaching Analytics with Cases* authored by the editor himself.

The effort that went into producing the book was clearly enormous. This is evident by the fact that the *INFORMS Body of Knowledge Committee* played an oversight role of the whole process of producing the book, giving guidance, advice and inputs. A separate group of experts acted as reviewers of the different chapters, providing detailed

reviews and critique. Lastly, there are extracts throughout the book presenting interviews held with practitioners and instructors of analytics on relevant topics.

Any book on analytics is inevitably going to provide a definition of analytics. It is stated upfront that the INFORMS definition of analytics, namely “*the scientific process of transforming data into insight for making better decisions*”, is used as the foundation for the book. However, many of the experts give their own view, interpretation and understanding of how they see and understand analytics. This is deliberate and enriches the presented content, enabling the reader to form his or her own view of what analytics is since there are so many angles to it!

It is only appropriate that Chapter 1 introduces analytics. Initially, a different perspective on analytics is provided, namely that analytics is considered broadly “*as a process by which a team of people helps an organization make better decisions (the objective) through the analysis of data (the activity)*”. A conceptual framework for analytics is then outlined as a continuous cycle where the analysis of data produces insights that informs better decision-making. Two approaches, a data-centric and a decision-centric one, are presented. In the data-centric approach, one gains insight into the data through the analysis of the data, which can then provide inputs into the decision-making process. The decision-centric approach starts with the decision that is required, using subject matter expertise and domain knowledge to relate decision variables to the target objective. It is not stated explicitly, but the problem to be solved needs to be defined and formulated upfront. The three main analytics categories, *descriptive*, *predictive*, and *prescriptive*, are defined and discussed. The considerations of how to use analytics within an organization is briefly touched upon, as well as the ethical implications of using analytics. Most of what is presented in this chapter is at a

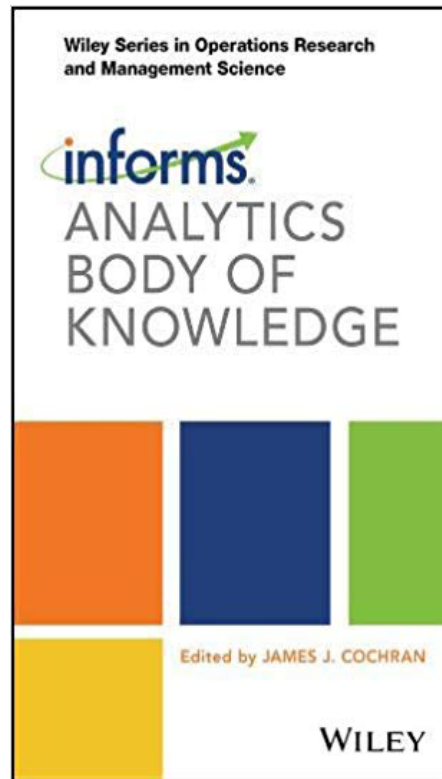
high, overview level.

Chapter 2 deals with how to get started with analytics. The main tasks are outlined. These are: selecting the target problem; assemble the team of analysts; prepare the data; selecting the analytics tools; and executing. Most of these are discussed in more detail in subsequent chapters. The chapter concludes with several real-world examples that had impact. These can be considered as *success stories*. Experience, as this reviewer can attest too, has shown the importance of *success stories*. The value, when marketing, of completed projects that proved to be beneficial to clients cannot be underestimated. Chapter 3 addresses the composition of the analytics team. What the needed skills are, how to manage the analytics team, how to best organise the analysts and data scientists, and where an analytics team should be located within an organisation (be it within the IT department, the strategy group, shared services, finances, etc.), are some of the issues addressed in this chapter. Where appropriate, more detail on an issue is provided.

The entire Chapter 4 is devoted to data and justifiably so given the absolute necessity of proper, relevant and good data for analytics. How many practitioners have not had the experience of clients indicating that *data is not a problem*? Only to find and realize that data is the biggest hurdle in trying to make progress! All aspects relating to data are discussed in detail and covered comprehensively. The chapter provides the reader with great insight and understanding of data types, data sources and how data should be prepared and modelled, while pitfalls in how data should be handled is highlighted. A whole section is devoted to data management with reference to data capturing, the needs and the role of data stewards, what metadata is as well as master data management. Data warehousing, as a data storage mechanism, is also discussed.

Chapter 5 and 6 are interlinked since both address problem-solving approaches. There are similarities and overlaps between these two chapters. A high-level framework is provided for analytical solution methodologies in Chapter 5. Three main solution methodologies are presented and discussed, namely macro-solution methodologies, micro-solution methodologies and thirdly method-related methodologies. This framework is not that well-known, at least not to this reviewer. Under macro-solution methodologies four main methodologies are covered, namely: the

scientific research methodology; the operations research project methodology; the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology; and the software engineering methodology. Most readers would be familiar with the OR project methodology but getting exposure to the other three is useful. The micro-solution methodologies are categorized into three main groups, namely those for exploration and discovery, those for using models (OR techniques) where techniques to find solutions are independent of data, and those using models (statistical) where techniques to find solutions are dependent on data.

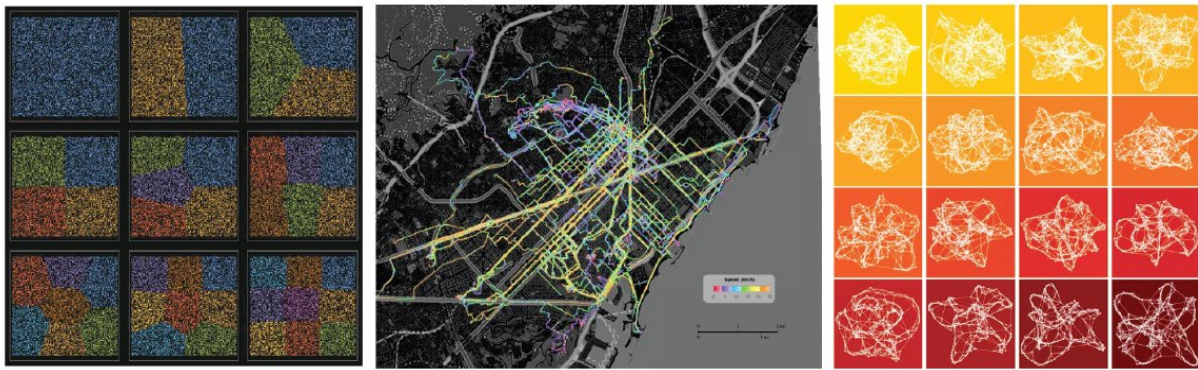


Chapter 6 is entirely concerned with modelling, and most of what is covered is the standard operations research techniques that most readers should be familiar with or would have been exposed to before. The first few sections focus on models, and specifically, why models are appropriate, the type of models one gets (descriptive, predictive and prescriptive), and the fact that models can be characterized by whether they are deterministic or stochastic. Some statistical concepts that are relevant are outlined and then a whole range of OR techniques, methodologies and approaches to modelling different problem types are presented briefly. In some cases, examples are used for illustrative purposes. The relatively new and fast-growing area of machine learning is the topic of Chapter 7. A brief introduction is given

followed by a description of supervised, unsupervised and reinforcement learning. All aspects concerning model development (machine learning algorithms) are presented. This is followed by an overview of supervised learning algorithms where methods described include: K-Nearest Neighbours (KNN); regression; Classification and Regression Trees (CART); time series forecasting; decision trees; Support Vector Machines (SVM); artificial neural networks; and ensemble methods. Similarly, unsupervised learning algorithms with methods designed to identify the latent structures in data, are presented. Models in this case include: kernel density estimation; association rule mining; Principal Components Analysis (PCA); clustering methods; and bag-of-words or vector space models.

The successful completion and implementation of analytics projects is heavily dependent on strong project management, deployment of the appropriate skills at the different stages during the project, as well as proper life cycle management. The analytics methodology that is described

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in Chapter 8 is based on the popular and accepted Cross Industry Standard Process for Data Mining (CRISP-DM) methodology. The six components of this methodology, which are: business understanding; data understanding; data preparation; modelling; evaluation; and deployment, maps well onto the INFORMS Certified Analytics Professional (CAP) Job Task Analysis (JTA). This is used in outlining the various project stages, the different steps and how these should be managed. Many of the older members of the OR generation are possibly not that familiar with this methodology, but it makes sense to link it to the INFORMS CAP approach. The chapter is concluded by emphasising the critical overarching aspects of life cycle management, namely documentation, communication, testing and metrics.

Many different skills are required in the analytics industry. An outline of key role players, or groups, in this industry are presented in Chapter 9 and their roles are briefly outlined. There is a shortage of skills in this industry at present. It is critical to have a good understanding of the talent needs in this industry. In the appendix the value of test cases used in teaching and how these can be used to provide students

with insight into the practice of analytics is outlined. Different aspects related to test cases are touched upon in the chapter.

In summary, the INFORMS ABOK is well-researched, well-structured and is a comprehensive source of the body of knowledge of analytics. All practitioners can be expected to benefit from being exposed to what is contained in every chapter of the book. For the practitioner many things will be reaffirmed, and will be familiar, but there are also many new things to be learnt and assimilated. The broad objective of the book “*to provide those interested in the development and application of the tools of analytics with an understanding of what analytics is and how analytics can be used to solve complex problems, make better decisions, and formulate more effective strategies*”, is more than adequately achieved. This book is therefore highly recommended!

**INFORMS Analytics Body of Knowledge** by James J. Cochran (Editor), 2019, John Wiley and Sons, pp. 370, ISBN-13: 978-1119483212 (Print) and ISBN-10: 1119483212 (eBook), 127.85 US dollar (Paperback), 139.76 US dollar (Kindle).