ORSSA

THE OPERATIONS RESEARCH SOCIETY OF SOUTH AFRICA
NEWSLETTER

FEATURES

FROM THE PRESIDENTS DESK

The Operations Research Society of South Africa (ORSSA) plays a pivotal role in fostering a community dedicated to the study and application of operations research (OR) methodologies to address real-world challenges.

In an era of rapid technological advancement and dynamic societal change, the way we promote and apply OR continues to evolve. These shifts present both opportunities and challenges as we strive to leverage OR for the benefit of broader society.

As we reflect on ORSSA's activities over the past year, it is essential not only to celebrate our achievements in advancing OR but also to acknowledge the enduring principles that underpin the field. These principles influence our broader perspective on life. That is, guiding us in addressing complex challenges, and this typically with limited resources.

I want to extend my heartfelt gratitude to each of you for your unwavering dedication and support of ORSSA's mission. While our conviction in the value of OR is grounded in sound theory and conceptual frameworks, our collective commitment underscores the transformative impact of OR methodologies across academia and industry alike.

Reflecting on the strategic goals set out by the EC in the beginning of the year, we are excited to report that we have met three of out five of the goals. That is, increase in university participation at the national conference, increase in industry participation at the national conference, and boosting of student membership through the academic member endorsement program. For the latter initiative, ORSSA gained ten new student members for 2024. A heartfelt thank you to the LOC of the 53rd Annual Conference led by Elzanie Bothma. You did an excellent job, not just in preparation but also in execution. The feedback from delegates, including several international attendees, has been overwhelmingly positive—a testament to your dedication and professionalism.

It is with sadness that we have to say goodbye to our ORSSA Secretary, Lieschen Venter. She is stepping down from her responsibilities after serving ten years on the EC. This is a remarkable achievement and on behalf of the Society I would like to thank you for your dedication and commitment throughout all these years of service.

ORSSA socials and insta-moments for 2024

One of the great perks of being an ORSSA member, affiliate or OR practitioner in the network, is the access to a wide range of networking and social events that provide an opportunity to connect with like minded people; 2024 was no exception. From Pi day, to special interest group hosted events, panel discussions with industry partners, webinars and the annual conference; there was something for everyone.

Pi Day celebrations

ORSSA members and their guests celebrated South African Pi Day by hosting gatherings in Potchefstroom, Stellenbosch and Sandton. This event brought the ORSSA family together to enjoy delicious treats while honoring the mathematical constant π. Globally, Pi Day is marked on March 14th, symbolising 3.14, the ratio of a circle's circumference to its diameter. However, in South Africa, we embrace the 22/7 representation of π, perfectly aligning with 22 July in our date format. This provided the perfect pretext for a unique celebration blending mathematics, South African culture, and delicious traditional milktart.

The event was an excellent opportunity for the ORSSA community to unite, share their passion for operations research, and appreciate the significance of π. Participants savored an assortment of exquisite milktarts, mingling and forming connections within the community.

Parallel events were held in Potchefstroom, Johannesburg, and Stellenbosch, allowing members across the country to partake in the festivities. The gatherings were a delightful mix of mathematical enthusiasm and cultural appreciation, reinforcing the strong bonds within the ORSSA community.

For details on upcoming events and further celebrations, keep an eye on the events page! To the right are some images of the Stellenbosch gathering where we were honoured to spend the evening with the wonderful prof Gerhard Geldenhuys

AI, Lawyers and the role of Automated Decision Making models in industry

On 16 April 2024 ORSSA, in partnership with the NRF and Norton Rose Fulbright South Africa, held an industry engagement on Automated Decision Making ("ADM"). In the recent years there has been an exponential growth and proliferation of Artificial Intelligence ("AI") systems and diverse use cases in industry. There is also a growing need to distil these concepts and ensure that people understand how to leverage these tools and understand their limitations.

The legal industry in particular has started to engage on a few provisions for governance and litigation of the unethical use of AI, bias as well us misunderstood applications of these systems in various industries, including financial services, healthcare and public services.

The session kicked off with Michelle David, (Director and Chairman of the Norton Rose Fulbright opening the discussion, sharing her own personal views on how ADM's have become a part of modern day life, from the start of day with Chat GPT assisting with ideas for dinner, self-driving cars, co-pilot suggestions in emails to personalised adverts on browsers based on text, speech and search history. The world of data science has fast expanded its uses beyond traditional spaces and it was fitting for the first presentation to locate the home and birth of data science, machine learning and optimisation - OR in practice. David Clark, our deputy president of ORSSA presented on the definition of OR, ORSSA as a community as well as the role OR practitioners have been playing for years in the business of better and automated decision making and support.

Gilad Katzav (Associate at Norton Rose Fulbright) shared insights from the perspective of a legal practitioner with case studies from industry where the use of ADM's had resulted in unfair outcomes for clients based on historical training data sets which had bias in credit scorecard processing that was performed by a third party vendor on behalf of a lending institution. This sparked engagements during the Q&A session, legal systems are holding institutions accountable for decisions they make that may have inherent or perceived bias, whether deliberate, automated or outsourced. The discussion highlighted the need for accountability in the use of data, its outputs as well as overlaying decisions with discretion. Something AI, hasn't quite figured out yet.

Dr Arno Both (Head of Credit Research and Development at FirstRand) presented on the traditional process of credit in banking, the definition of trust and the role of the banks in allocating capital throughout the economy. He demonstrated the life-cycle of the credit process in banking, from identifying which clients banks would like to lend to, ways to market credit to them, tools for assessing their affordability, score card modelling, to the determination of future re-payments and the likelihood of expected default through behavioural modelling. In each component of the credit life-cycle, large financial institutions leverage automated decision tools differently to optimise their business through targeted marketing based on personal banking trends, projecting future income and affordability profiles and triggers to determine recovery action processes when credit goes bad.

Jess Rees, our resident OR practitioner and lead data scientist at Discovery Science Lab, presented on use cases on Large Language Models ("LLM") in the insurance industry for call centres. Typically, peoples experience of call centres can range from a great operator that is knowledgeable about the relevant product, but with a terrible bed-side manner or the friendliest operator that perhaps just started on the job yesterday but has limited company knowledge on the products and offerings. LLM-based systems trained on internal information and policy data for the company can be used as an in-house search engine, allowing operators to focus on the human element of engaging with the customer and then looking up specific (and hopefully, non-hallucinatory) information as requested by the client. The robot is not exposed to the customer, operators are trained on efficient prompts and there's the wonderful benefit of learning for everyone involved (the bots included).

David opened up the panel discussion which included the presenters as well as, Dr Martin Bekker (Computational social scientist and AI ethics researcher) and Thloni Mhango (Head of Financial Risk at FirstRand and OR practitioner). The audience had plenty of questions on whether smaller organisations could contend with the AI tools and in-house capabilities typically afforded by larger institutions; to which Jess remarked on the number of open-source tools available that are accessible to users. However, as with all things, caution was required in order to truly understand the training data used on open source systems as well as overlaying decisions outputs with discretion. Dr Bekker also challenged the audience to reflect on the ethical components of AI tools and systems, including how to leverage information systems and design ADM's that give reliable results. There were many thoughts on the role people play in the application of ADM's and Thloni charged the audience to always remember that AI and its uses require discernment, whether in ensuring non-biased training, testing the outcomes of ADM models and ultimately ensuring that decisions result in positive outcomes for humanity.

In closing, there was consensus that the extensive use of ADM's and the applications thereof, are exciting and really allow humans more time to focus on creativity and critical thinking tasks. However, the take-home was that the model lifecycle for these models requires iteration, accountability and human intervention where the decisions impact society. The opportunities for scalability extend beyond the usage by large organisations given the growth of open source AI, smaller organisations can tap into these tools with the right third party due diligence and transform their operations.

Celebrating women in OR

The OR network worldwide has an abundance of female practitioners pioneering in industry and representing the practice in their various sectors. This year, ORSSA was proud to celebrate one of our own during women's month in South Africa!

During Women's Month in South Africa, we recognised and celebrated none other than our own Jess Rees; lead data scientist at Discovery currently specialising in the development of Large Language Models and their use in the insurance and financial services industry.

Jess (29) is no stranger to accolades, having graduated from the University of Pretoria with her Master in Big Data Science, and her undergraduate and honors in business science from the University of Cape Town; picking up Deans merit awards along the way and also completing her Certified Analytics Professional (CAPs) Exams. She has also taken on many leadership roles in her career both at Discovery and as an ORSSA EC member, driving innovation, responsible programming and AI, as well as mentoring future scientists.

That said, everyone who knows Jess, knows how much she enjoys a good evening of intellectual games, snacks and socialising with like minded people. She's got immense gratitude for all her prior mentors and school advisors and continues to be a great sounding board for colleagues and up and coming students alike. We also super proud of her recent nomination from the Mail and Guardian 200 Young South African award for 2024, under the category of "Technology and Innovation".

Developing young talent in OR

The development and use of OR in Africa is an important component of ORSSA. As such the Local Organising Committee (LOC) of the ORSSA 2024 conference offered the Development Package Sponsorship again this year to support promising students from different universities. The sponsorship provided attendance, travel and lodgings for the conference.
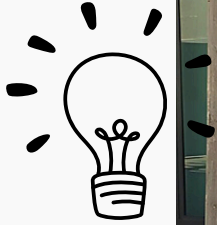
The LOC was once again very excited to accept the an offer from the NWU Centre for Business Mathematics and Informatics to buy this package. Their sponsorship enabled Serutle Moeng and Florinda Maningue from the School of Mathematical and Computer Sciences at the University of Limpopo to attend as student delegates. ORSSA further matched the number of sponsored students one-to-one to increase access to the event. The students provide the following feedback to express their thanks:

Serutle writes, "I would like to express my sincere gratitude for sponsoring my attendance at the 53rd annual ORSSA Conference at Skukuza. It was an incredible experience to witness the wide range of applications and methodologies used in OR. Before being introduced to OR, I had little interest in pursuing my degree further, as it seemed limited to mathematics, computer science, or statistics. While those fields are valuable, they didn't offer me a clear connection to solving real-world problems in our country.

At the ORSSA conference, I had the opportunity to learn about various research projects addressing pressing issues. For example, Robert Bennetto's "A Tale of Two Grids" focused on solving the load shedding crisis, Lize Visser's work tackled the "Inventory Routing Problem," Hannah Callaghan presented on "Mobile Clinic Deployment," and Sheetal Silal discussed "COVID-19 Modelling," among others. These presentations inspired me deeply and showed me how OR can be applied in the professional world. I also had the chance to engage with some of the presenters, gaining valuable advice and motivation to continue my studies so that I too can contribute to improving people's lives.

The conference further inspired me to collaborate with my lecturer, Mr. Dikgale, in encouraging more students at our university to enroll in OR courses. I can now confidently define OR as the use of scientific methods and analysis to solve complex problems by breaking them down into fundamental components while considering the costs associated with decision-making.

The highlight of the conference was the bush braai. Although I thoroughly enjoyed it, I must admit I was a bit nervous, imagining I might have dinner while the lions considered me theirs!" Florinda writes, "I would like to express my sincere gratitude for the sponsorship that allowed me to attend the 53rd Annual ORSSA Conference held in Kruger National Park. It was an enriching experience where I had the opportunity to engage with experts in OR and statistics, gain insights into the latest research, and network with fellow students and professionals. I am deeply grateful for the exposure.

From LTR: Phil Dikgale (supervising lecturer), Florinda Maningue, and Serutle Moeng.

The conference had several highlights for me. I was particularly fascinated by the presentations on dynamic complex systems analysis, especially the discussion on the notion of time and path inconsistency and the challenges of maintaining consistent decision-making paths in dynamic systems. I also found the session on IRP formulation insightful. One presentation that resonated with me was about predicting learner progress in South Africa. It made me reflect on how the stability of a learner's environment significantly impacts education—a fact that should motivate learners to strive for better. A memorable quote from the session was, "Help a child get a father before they get basic education," which struck a chord with me.

Another captivating session focused on graph theory. The discussions on basement weapon aim, cell phone tower location relative to network coverage, and different types of domination, as well as topics like harvest scheduling and graph transversals, were incredibly informative. I also learned about the b-coloring of regular graphs, which can be used to organize training sessions or other activities. The overview and comparison of heuristics for the generalized bin packing problem were particularly remarkable, highlighting the strategies and factors considered in efficient packing. Being surrounded by individuals with a deep understanding of OR was also an invaluable experience. I didn't need to struggle to explain OR, and it was inspiring to see how diverse the field is and how widely it is applied across various industries. The presentations helped me refine my interests, particularly in scheduling and routing problems, such as the Travelling Salesman Problem. The conference not only deepened my understanding of OR but also solidified my decision to pursue a BSc Honours in Operations Research in 2025 and become more actively involved in the OR community. This conference was both educational and enjoyable, and I am incredibly thankful for the opportunity to attend."

If you would like to sponsor students to attend the next ORSSA conference, contact the Society Secretary today for a copy of the latest sponsorship prospectus!

A walk down memory lane as we explore the history of OR in South Africa

This year ORSSA launched another exciting Special Interest Group (SIG), dedicated to preserving and documenting the history of Operations Research in South Africa and on the African continent at large.

The youngest ORSSA SIG – History of OR in SA – was launched on 13 March 2024, just a day before Pi Day! We were privileged to visits behind the scenes of the early days of OR in the South African chemicals industry.

Our guide was Dave Evans, who spent the first 28 years of his career in the chemical industry. Dave grew up near York, England, obtained an MA in Biochemistry from Cambridge University and an MSc in Operational Research and Management Studies from Imperial College, London University, after which he joined ICI in England. In late 1970 Jim Buttery, OR manager at AECI in South Africa, was sent on a "technical" visit to ICI by his production director, Harry North, who was quite familiar with the use of OR in industry. Jim returned with among others John Hudson, Dave Bromley, Alan Hawcroft, Brian Fuller, Geoff Knights, James Grant, and Dave.

Some of the OR at AECI involved linear programming for monthly budgeting purposes, annual scenario planning, and capital investment decisions over twelve-year periods. The largest computer in Africa was utilised namely an IBM 360 at Anglo American's Dedicated Data Centre with half a megabyte core memory. It could handle 800 variablefs and 600 equations, and completed a run in one hour. This required clever modelling since maintaining mass balances across two factories, 25 plants, 15 products and six sale regions potentially could involve 3 000 equations... Multi-time period models were built by hooking together up to twelve models through stock and cash flows. The objective was to maximise profit – ignoring pollution, energy consumption, global warming and similar complexities.

Discrete event simulation models were developed with the aid of IBM's General Purpose Simulation Software (GPSS). Such models included a scheduling model that was developed to such a level of detail to include tea breaks, and when the first PCs became available another model was developed to determine the number of computers required by the company. Differential equation modelling also was done with the Continuous Systems Modelling Package (CSMP). These models decomposed into Fortran and then Assembler.

Dave's hairstyles are testament that we need to document our history!

One example of an OR project – the "R100" project – involved meta-modeling of capital investment with uncertain returns. Effectively developing Excel in Fortran, a discounted cash flow model was constructed. Future market share was estimated for the current situation with most factories far away from customers, an expensive inflexible distribution infrastructure, weekly or fortnightly rail deliveries to customers, and each customer maintaining extensive storage facilities. This was compared with possible market share if an additional R105M ("R100") was invested to construct new factories or distribution sites closer to customers with just-in-time deliveries. This would entail lower costs to customers and more difficulties for new entrants into the market. Legislative implications had to be considered for both situations. Iso-profit lines for the return on investment were developed and a best estimate was made. The investment went ahead and 40 years later the division is still in business. Although the optimality of the decision could never be proved, this is a good example of decision support where a decision without the model would have been largely guesswork.
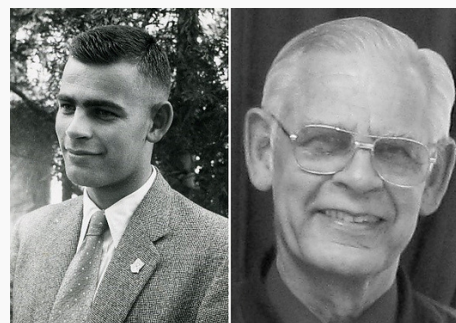
The history of OR in the South African chemicals industry shows that operations researchers not only effectively support better decision-making. They also pragmatically support decision-making by intelligently utilising what is available. And they build long-term trust relationships with the decision makers. Thanks, Dave.

If you would like to share your story on the history of OR in South Africa, please contact Gavin le Roux, ORSSA Head of External Liaison.

Eye witness of the early years of operations research in South Africa

The ORSSA SIG on the history of OR in South Africa was privileged on Tuesday 13 August to learn from another honorary life member of the Society namely Gerhard Geldenhuys. Gerhard is an emeritus professor of applied mathematics at Stellenbosch University. He has been instrumental in mentoring numerous OR students and professionals – of whom many are ORSSA members – and in shaping the direction of OR in South Africa. The prestigious medal awarded to the winner of the honours or fourth-year category of the annual national student competition therefore is named after him.

Gerhard reflected on activities in OR in various fields in South Africa from the 1950s until the mid 1980s. For example, in 1959 a group of honours students in mathematics at the University of Stellenbosch discovered a book in the university library on OR by Churchman, Ackoff and Arnoff published in 1957. It contained case studies on inventory modelling, allocation modelling, waiting-time modelling, replacement modelling and competitive modelling. Although the book was not prescribed in the course, the group decided to read and discuss it on their own and were very excited about the possibilities of similar applications in South Africa. It sounds like a SIG on OR...

While studying at Harvard University in 1962, Gerhard joined the American Operations Research Society and purchased all the published volumes of their journal Operations Research. He was surprised to hear that Bob Tusenius from the Council for Scientific and Industrial Research (CSIR) in Pretoria attended the founding conference of the International Federation of Operational Research Societies (IFORS) in 1959. On his return to South Africa, Gerhard was recruited by Alewyn Burger to conduct a survey of the possible applications of OR in South Africa, and to present a series of lectures on OR for the staff at the National Research Institute for Mathematical Sciences (NRIMS). Alewyn established the NRIMS at the CSIR in 1961, which played a huge role in the development of OR in South Africa. At that stage, OR was already applied in South Africa in mining by Danie Krige and Herbert Sichel. Herbert established a consulting company namely the Operational Research Bureau in 1952 and may truly be called the father of OR in South Africa. OR also was applied in the PUTCO bus company in Johannesburg, the South African Railways, the South African Defence Force, and the South African Iron and Steel Industrial Corporation (Iscor). Members of the NRIMS gradually moved to universities to establish OR courses at various universities, making use of the lecture notes compiled by Gerhard. We are grateful to Hans for offering to donate a copy of these to the ORSSA archives. NRIMS members also moved to other organisations to apply OR such as the post office and Iscor. A number of young operations researchers in the meanwhile returned from studies overseas to strengthen offerings at universities and to apply OR for example in the banking sector and the Atomic Energy Board. OR also was applied in copper mines in Zambia and the African Explosives and Chemical Industries (AECI). The above pioneers of OR in South Africa worked very hard to gather interested individuals from diverse fields throughout the country to establish the OR Society of South Africa at the University of the Witwatersrand on Thursday 20 November 1969. Maybe something similar could be done to regather all individuals practicing OR throughout the country?

Gerhard continues to play an important role in archiving and reflecting on the history of OR and ORSSA to preserve the knowledge and methodologies developed over many years. He keeps inspiring young OR practitioners to learn from past achievements and challenges. Gerhard also played a pivotal role in my decision to follow a career in OR through a one-on-one discussion which he had with each of his third year students. Thank you for ensuring that OR continues to grow and adapt to new challenges.

OR conference in the bush

This year, the LOC organised a fantastic and well attended annual ORSSA conference at the stunning Mdhluli conference center and lodge in the heart of Kruger National Park! Guests and delegates alike were spoiled to the heat of the African sun, game drives and engaging presentations from our presenters and key note speakers!

There was plenty of wisdon roaming around the conference

The conference brought together participants from diverse fields, providing a platform for knowledge sharing, networking and collaboration. The program spanned over three days and included multiple talks, plenaries, tutorial sessions as well as panel discussions.

The non-academic program consisted of a bush-braai, game drives, a boma dinner and dinner on the infamous Kruger Shalati train.

A quick selfie to get everyone in the zone before the next presentation

This year we had the pleasure of two key-note speakers for the conference including Rohit Kumar, founder and president of FinPlusTech Inc as well as Professor Jan H Van Vuuren, Head of the Stellenbosch unit for OR in Engineering.

There were two panel discussions at the conference this year, the first led by Renette Blignaut on "Data analytics and artificial intelligence (AI) in financial analytics - which areas of analytics form part of AI? The second plenary was led by Shital Silal on the topic "Operations Research supporting decision making - from academia to government".

There were plenty of opportunities for stargazing and reflection under the African sky

But at ORSSA we also take time to recognise our own stars...

2024 ORSSA WARDS

The Gerhard Geldenhys medal is awarded in recognition of the best honors or Masters project. This year the award went to Hannah Callaghan for her Masters project titled, "Mobile clinic deployment in the Witzenberg region of South Africa" under the supervision of Prof Linke Potgieter.

The Theodore Stewart medal winner was Himil Parshotam for his thesis titled, "A framework for evaluating clinical data using graph-based link prediction",

Recognition award

The recognition award is given to individuals who have served the profession of OR in an exemplary fashion. These awards are considered a prestigious distinction and are reserved only for a prestigious distinction and are reserved only for outstanding achievements and/ or contributions typically over a long time. This year, the society recognised Professor Hennie Kruger for his contributions to OR!

Tom Rozwadowski Medal

The Tom Rozwadowski medal is the Society's premier award and has been presented on an almost annual basis since 1971. The medal is awarded for the best written contribution to Operations Research made by a member of the Society during the previous year.

This year the medal was awarded to Silal Pulliam, Meyer-Rath, Jamieson Nichols, Normal et-al for their paper entitled, "The National COVID-19 Epi model (NCEM): estimating cases, admissions and deaths for the first wave of COVID-19 in South Africa.

Thank you to our conference sponsors

A big thank you to our 2024 conference sponsors:
- The department of Industrial Engineering from Stellenbosch University for sponsoring all the social events.
- The Centre for Business Mathematics and Informatics at North West University for sponsoring two student delegates of OR as part of the Society's developmental strategy.
- The department of Statistical Sciences and the Modelling and simulation hub, Africa (MASHA) at the university of Cape Town.

Thank you to our 2024 ORSSA Executive committee

Putting a conference together whilst keeping the society members on their toes throughout the year is no easy task. A warm thank you to our 2024 EC members for making the conference a success and keeping the OR network alive in South Africa!

A note from the Editor

What a year 2024 has been! There has been so much happening in the external environment and developments that impact OR and we are all due for some much deserved rest with loved ones. For those travelling over the festive season, be safe. For those at home, take care and enjoy reading some of the many articles and publications from our website blog, our in-house journal ORION and conference proceedings!

On behalf of the ORSSA EC, I would like to wish all our members, affiliates and sponsors a very happy and restful festive season.

If you still haven't finalised your Christmas gift shopping, there is still time to gift yourself or someone you know, the gift of an annual ORSSA member subscription. Details are available here: https://www.orssa.org.za/membership . Benefits include all the below and the opportunity to join a special network of practitioners.

Event discounts	Journal access	Enhanced networks
Member discounts	Shape the Society	Awards