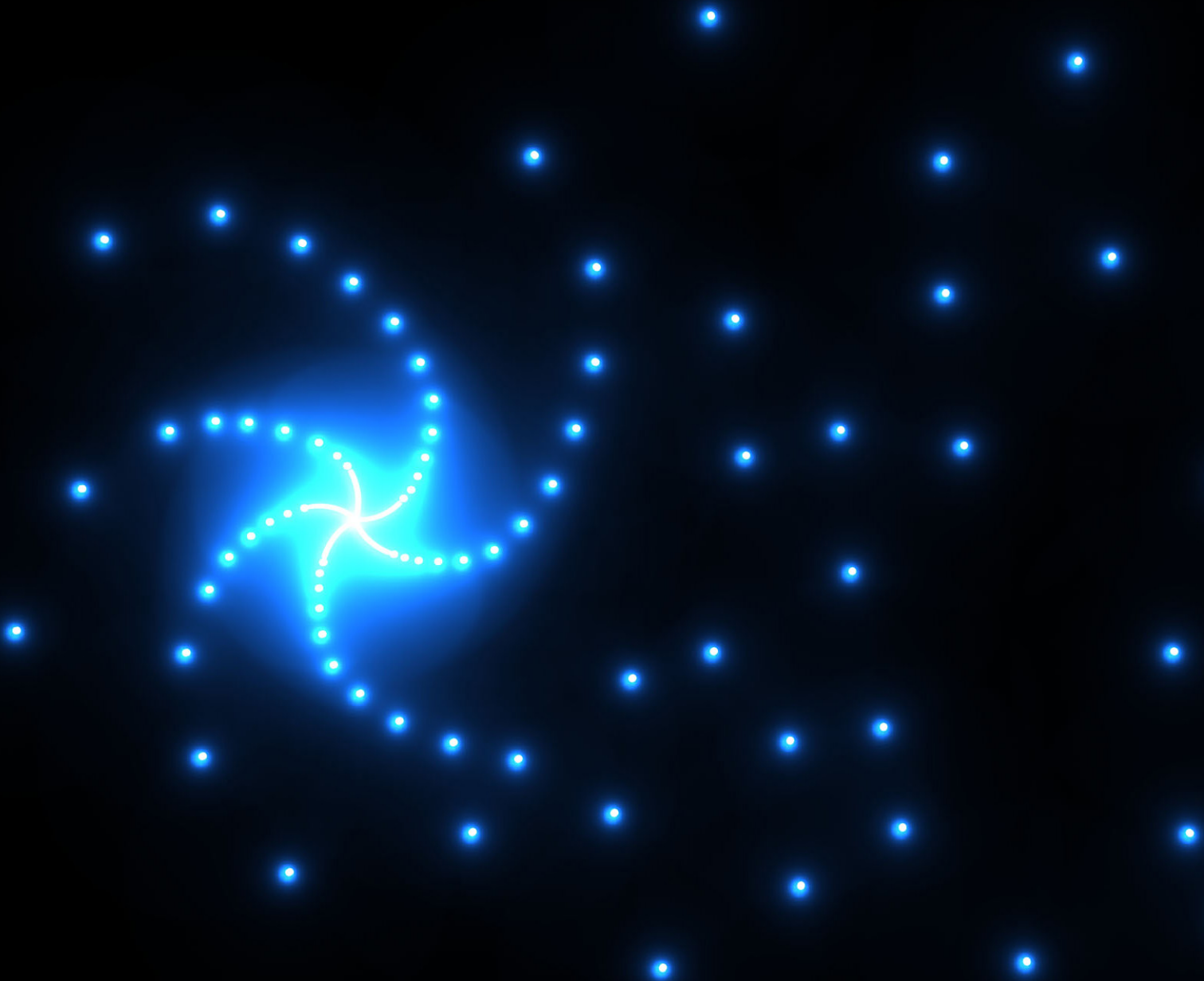




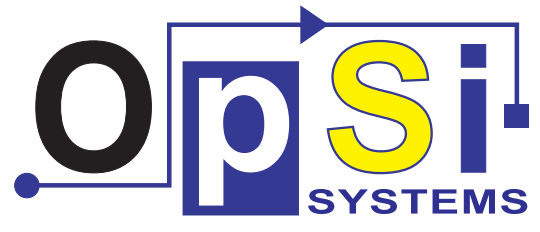
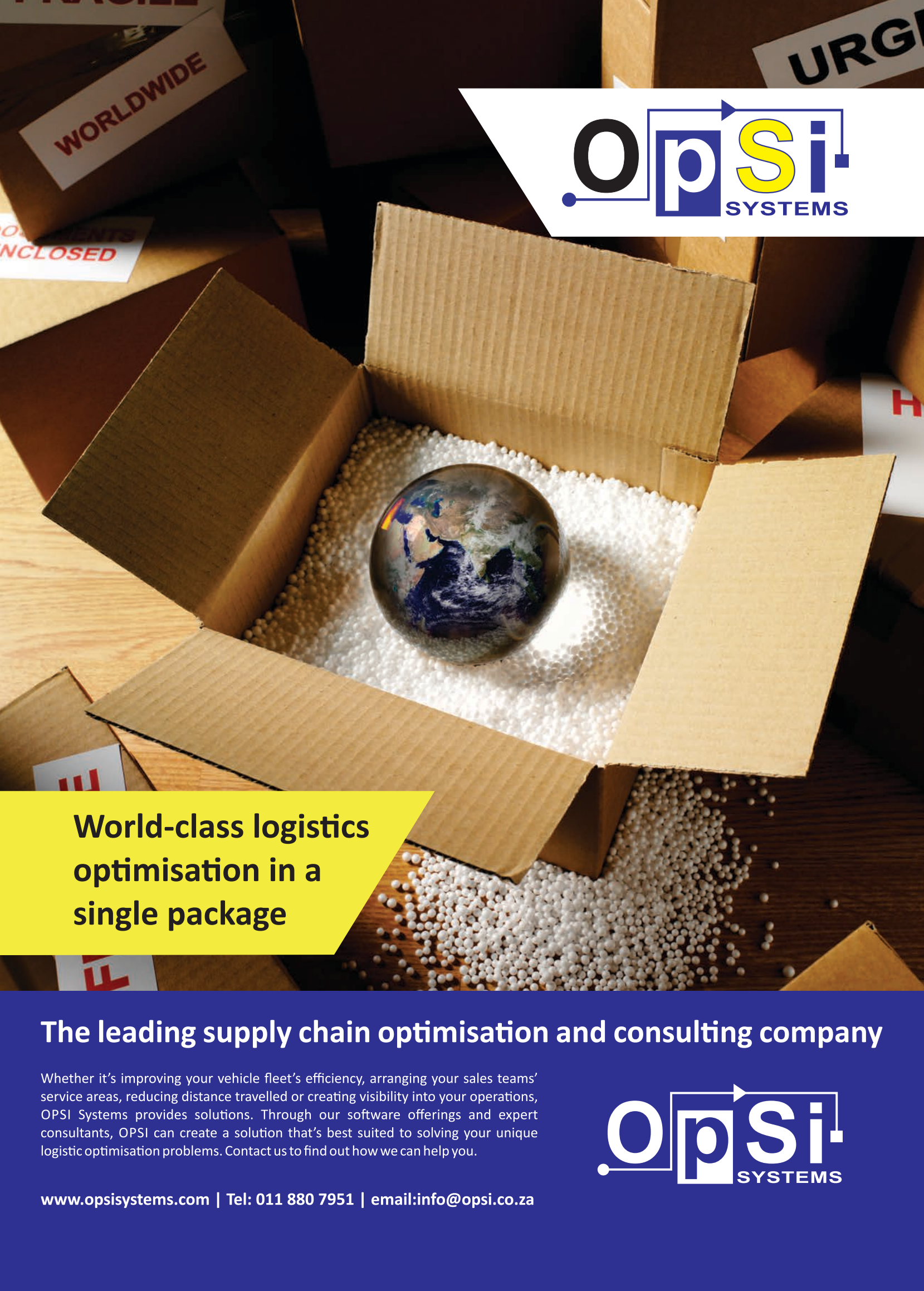
AT THE FOREFRONT OF ANALYTICS IN AFRICA



ORSSA Newsletter June 2015

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FROM THE EDITOR

By **BERNIE LINDNER** (berndtlindner@gmail.com)



Bernie Lindner

Welcome to the July edition of the ORSSA Newsletter. I could say that the year has flown by, but that could be said for every year and there is, in fact, always 60 seconds in every minute.

At the end of last year I was fortunate enough to attend a public talk on the *Square Kilometre Array* (SKA) by Professor Howard Reader (a Lecturer in Electrical Engineering at Stellenbosch University) and was awe-struck by the project (some call it the biggest science project of the century). He tried to highlight the point that most of scientific research has driven technology. However, with the SKA project technology is now the limiting factor. In particular, new technology is needed to handle all the data and computing power required by the SKA project.

Since then I have been trying to find OR problems or applications relating to the SKA project. After a bit of Google searching (SKA Operations research, SKA optimise, SKA optimize, SKA optimisation, SKA linear programming, you catch my drift) I could, however, only find one link containing this newsletter's cover picture with the words "the spiral layout design has been chosen after detailed study by scientists in how to optimise the configuration to get the best possible results." How did they optimise this?

Fortunately a masters student, Johannes Rens, from the Department of Civil Engineering at Stellenbosch University came probing my supervisor, Prof. Jan van Vuuren, about optimising problems for his masters project, which focusses on construction management for the SKA project. I could gather some information from Johannes in the form of an article which highlights some OR applications in construction projects for the SKA (page 5).

If you haven't heard about the SKA, then I am a bit jealous (similar to somebody watching an epic movie for the first time, you want that feeling again of seeing or learning something for the first time). The first time I heard about the project I couldn't comprehend it, and I still struggle to do so. The article on page 3 gives an overview of the project as well its massive scale, both physically and technologically.

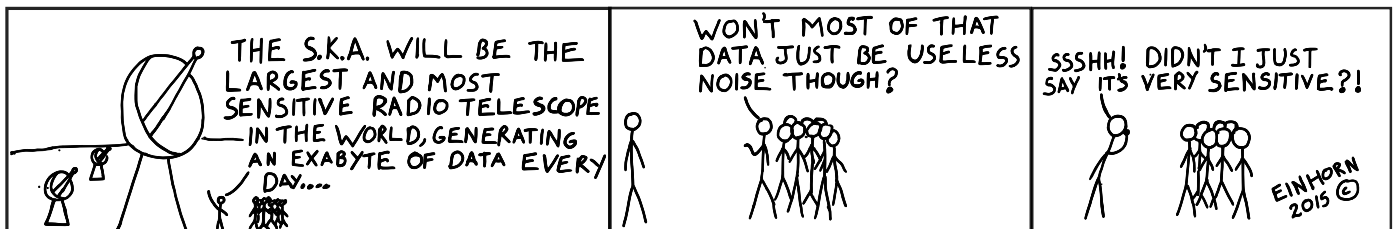
You will also find an advertisement and an article on the EURO conference, as well as some feedback from two ORSSA members who attended the 6th OR Practice in Africa Conference, held in Algeria (page 6). This edition also contains a review on the movie *Moneyball* (a must see, especially for operations researchers or statisticians) and a book review on *The Root of Logistics*. The editions finishes with an *Ode to Kriging*.

I hope to see many of you at the next ORSSA conference at Pecan Manor, Hartbeespoort valley in mid September.

Please feel more than free to contact me for any submissions, queries or suggestions.



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FROM THE PRESIDENT'S DESK

By HENNIE KRUGER

(Hennie.Kruger@nwu.ac.za)

ORSSA PRESIDENT



Hennie Kruger

The June edition of our Newsletter signals the end of the first semester of the year. I trust that you all had a productive, albeit enjoyable, first semester and that you are looking forward to the last six months of 2015.

This is also the last edition before our 44th Annual Conference which will take place at Pecan Manor in the Hartbeespoort valley from 13-16 September 2015. The conference, with the theme *Future Analytics*, is organised jointly by the Johannesburg and Pretoria Chapters, with Robert Bennetto as chairman of the LOC. Registration is already open and everybody is encouraged to register and organise their accommodation as soon as possible. Details of the conference can be found on the ORSSA webpage (www.orssa.org.za) as well as on page 9 of this newsletter.

The LOC has once again secured a number of sponsors for the conference. I would like to thank both the LOC for their efforts and the sponsors who have agreed to support the conference. Sponsors so far include OPSI Systems, Blue Stallion, North-West University (Centre for BMI), the Department of Logistics at Stellenbosch University and the Department of Industrial Engineering at Stellenbosch University.

The conference keynote speakers this year will be Michael Trick from the Tepper School of Business at Carnegie Mellon University and Russ Taylor from the University of Calgary. We are looking forward to what promises to be very interesting and exiting presentations from both keynote speakers. More details of these two international researchers can be found on the ORSSA 2015 Conference website under *Keynote Speakers*.

The different chapters seem to be well and alive. I have received a number of notices of chapter events and I would like to say a special thank you to the chapter chairs, chapter committees and all members who organise and attend the chapter events. The Meetup groups that came into existence last year are very active and members are encouraged to support these meetings. Meetings are regularly held in the Johannesburg, Pretoria and Western Cape chapters. Some of our activities are now on social media and you may want to look us up on Facebook (where you can "Like" our page) and Twitter (@_ORSSA). Other news from the Executive Committee is that there has been a reshuffling

of portfolios. Louzanne Oosthuizen (Database Administrator) has moved to an Additional Member portfolio with responsibility for liaison with SAIIE. Dave Evans has been called up for duty again and is the new Database Administrator. Thanks Dave for helping us out (again!) and thank you Louzanne for staying on in the Executive Committee to handle all matters related to the SAIIE.

Statements of payable membership fees were sent out with the March Newsletter and I would like to encourage all members to settle their membership fees. In some instances payments are overdue and I would like to request your assistance with these payments to help ensure that the Society can continue delivering a proper service to its members. Enquiries about the statements or any other financial related matters can be directed to the treasurer, Tiny du Toit, at Tiny.duToit@nwu.ac.za

In conclusion, thanks to everyone for the contributions made to keep our Society at the forefront. Thank you to every member of the Executive Committee for managing his or her portfolio in a professional way amidst severe working pressures. As always, please feel free to contact me, or any member of the Executive Committee should you have any request or ideas that could help us to improve the Society's service to its members. I hope to see many of you at our annual conference in September.

With best wishes / Alles van die beste
Hennie Kruger

SOCIAL MEDIA

- **Facebook:** Please visit (and like!) our page at www.facebook.com/ORSAocietySA.
- **Twitter:** @_ORSSA_.
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QUERIES & CONTRIBUTIONS

Any queries or contributions to the Newsletter are most welcome, especially article submissions. For any queries or contributions, please contact the Newsletter editor at berndtlindner@gmail.com.

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

BIG DATA FROM THE BIG BANG

by *Berndt Lindner, Department of Industrial Engineering,
Stellenbosch University (berndtlindner@gmail.com)*

The Square Kilometre Array (SKA) is set to be completed by 2024. It will be the world's largest and most sensitive radio telescope, about 50 times more sensitive, and up to 10 000 faster (in terms of its survey speed) than the best radio telescopes of today. It will, in fact, be powerful enough to sense radio waves from objects millions or even billions of light years away from Earth [3].

Thousands of radio telescope dishes (around 3 000) and other antennae will be linked together (over a distance of more than 3 000 km) in the form of a spiral galaxy, with most of the telescopes concentrated in an inner core, and the rest arranged into a set of arms up to 3 000 km long. Fibre-optic cables will link each of these dishes to a central processing area, where supercomputers will stitch their data together. It will be the largest and most powerful radio observatory ever built. The collecting areas of all the receivers that make up the SKA will add up to one square kilometre, thus its name [5].

Location

The SKA was originally conceived in 1991, with an international working group set up in 1993. Suitable sites for the SKA telescope need to be in unpopulated areas with guaranteed low levels of man-made radio interference. Four sites were initially proposed in South Africa, Australia, Argentina and China. After considerable site evaluation surveys, Argentina and China were dropped and the other two sites were shortlisted (with New Zealand joining the Australian bid, and eight other African countries joining the South African bid). In 2012 it was announced that the SKA would be split over the African sites and the Australia and New Zealand site [5]. The core site for Australia is located near Boolardy in Western Australia [5, 7].

In South Africa, the core site is located at an elevation of about 1 000 metres in the Karoo area of the arid Northern Cape Province, about 75 km north-west of Carnarvon, with distant stations in Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia.

Big Project

As the SKA Project Director, Professor Richard Schilizzi said: "The SKA promises to be one of the top global science projects of the 21st century. Using innovative receptor technologies and one of the world's most powerful supercomputers, the SKA will probe the origins of the universe [6]. The ambitious project, which brings 67 scientific teams from 20 countries together, is the next big thing in global



Artist's impression of the SKA dishes [6].

scientific collaboration [1].

The project is estimated to cost €1.5-2 billion and will be ready by 2024. The funding comes from many international funding agencies [5, 6].

The projected milestones for SKA South Africa are [3]:

- 2014–2017: Building the 64-dish MeerKAT array (while design and planning for the SKA is underway)
- 2017–2020: Construction of SKA Phase 1 (scientists can already do research with MeerKAT)
- 2020–2024: Construction of SKA Phase 2 (including outstations in African partner countries)
- 2024: The SKA is ready to do research

Purpose

The capabilities of the SKA are designed to address a wide range of questions in astrophysics, fundamental physics, cosmology and particle astrophysics as well as extending the range of the observable universe. A number of key science projects have been selected to be undertaken by the SKA and are related to [5]:

- Extreme tests of general relativity,
- Galaxies, cosmology
- Dark matter and dark energy
- Probing the Dark Ages
- Cosmic magnetism and
- the search for extraterrestrial life.

Amongst its functions, the SKA will be able to collect radio waves carrying signals from gas clouds emitted before the formation of the first stars. This will make it possible to look back billions of years in a bid to reveal how the universe formed immediately after the Big Bang. It will even test Einstein's theory of general relativity [9].

Massive Data

The SKA represents a new step in terms of data management and the complexities of project coordination. The instrument will generate an exabyte (10^{18}) of data every day – that is 1 000 000 000 000 000 000 bytes – more than twice the information sent around the internet on a daily basis and 100 times more information than CERN'S Large Hadron Collider (LHC) produces [1, 2].

According to Ronald Luitjen, a senior manager at IBM's Zurich Research Lab "The challenge is fundamentally one of scaling, and the only little issue is that we don't know how to do this. Today's technology will not scale with density and energy in order to build the SKA." Luitjen describes the necessary advances as a quantum leap in data storing techniques, "comparable to going from an optical microscope to an electron microscope," a jump that opened a world of new opportunities to nanotechnologists and biologists.

"This is big data analytics to the extreme"

The computer power needed for the SKA will be about three times more powerful than the most powerful supercomputer in 2013 [8]. The reason the SKA needs so much computing power is apparently because scientific image and signal processing for radio astronomy imaging consists of several fundamental steps, all of which must be completed as quickly as possible across thousands of telescopes connected by thousands of miles of fibre optic cable. The computers must be able to make decisions on objects of interest, and remove data that are of no scientific benefit, such as radio interference from things like mobile phones or similar devices, even in the remote locations which will host the SKA. [8]

Processing the vast quantities of data produced by the SKA will require very high performance central supercomputers capable of in excess of 100 petaflops (one hundred thousand million floating point operations per second) of raw processing power [8]. "This is big data analytics to the extreme," said IBM Research scientist Ton Engbersen [9].

DOME project

To solve this unprecedented challenge, IBM scientists in the Netherlands and Switzerland, and as well from ASTRON, the Netherlands Institute for Radio Astronomy, have launched an initial five-year collaboration called DOME—named for the protective cover on telescopes and the famous Swiss mountain. DOME will investigate emerging exascale technologies including data transport and storage processes, and streaming analytics that will be required to read, store and analyse all the raw data collected daily.

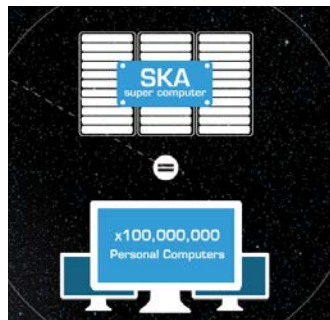
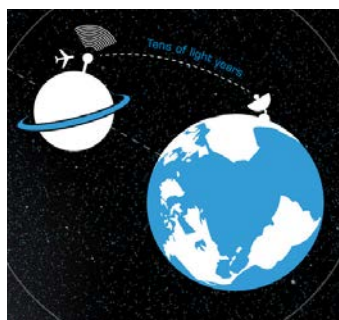
Only by basing the overall design on architectures that are beyond the current state-of-the-art will it be possible to handle the vast amounts of data produced by the millions of antenna systems of the SKA [9].

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- [3] <http://www.ska.ac.za/qa/>
- [4] <https://www.skatelescope.org/amazingfacts/>
- [5] http://en.wikipedia.org/wiki/Square_Kilometre_Array
- [6] <https://www.baesystemseducationprogramme.com/what-is-engineering/telescope-network.php>
- [7] <https://www.skatelescope.org/projecttimeline/>
- [8] <https://www.skatelescope.org/software-and-computing/>
- [9] <http://www.research.ibm.com/news.shtml>
- [10] <http://www.economist.com/node/21556207>

Some Amazing SKA Facts [4]

1. The SKA will be so sensitive that it will be able to detect an airport radar on a planet tens of light years away.
2. The SKA central computer will have the processing power of about one hundred million PCs.
3. The dishes of the SKA will produce 10 times the global internet traffic.
4. The SKA will use enough optical fibre to wrap twice around the Earth.
5. The aperture arrays in the SKA could produce more than 100 times the global internet traffic.



SITE LAYOUT PLANNING FOR THE SQUARE KILOMETRE ARRAY PROJECT

by Johannes Rens, Department of Civil Engineering, Stellenbosch University (johannesrens@gmail.com)
and Berndt Lindner, Department of Industrial Engineering,
Stellenbosch University (berndtlindner@gmail.com)

Overview of project

The first author is busy with his second year masters studies in the Department of Civil Engineering at Stellenbosch University. His project focusses on construction management for the *Square Kilometre Array* (SKA) project. Three problems within this project are of interest to operations researchers and are highlighted below.

Site layout optimisation

The SKA site stretches over a very large area. Currently it is planned that approximately 50% of the collecting area will be contained in a dense central array of 5 km in diameter to provide high brightness sensitivity at arc-second scale resolution for studies of faint spectral lines from structures in the early universe. Another 25% of the collecting area will be located within a diameter of 150 km; Figure 1 shows a possible layout for this array with arms in a spiral pattern and with a diameter of 150 km. The remaining 25% of the collecting area will be at baselines of 3 000 km or greater [2].

Whereas construction of antenna foundation may be large distances from temporary facilities such as batch plants, site offices, laydown yards and various workshops, the plan-

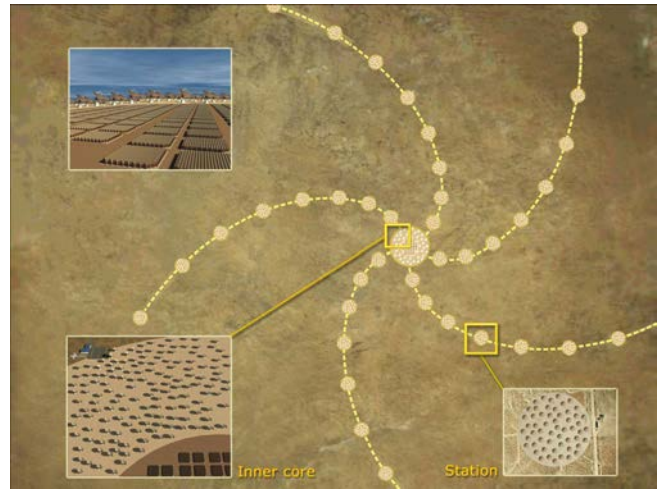


Figure 1: A possible layout for the SKA array with arms in a spiral pattern with a diameter of 150 km [9].

ning site layout entails the identification of the locations of temporary facilities. A proper site layout can lead to: (1) reducing material handling cost; (2) minimising travel times of labour, material, and equipment on site (3) improving construction productivity; and (4) promoting construction safety and quality [4]. Therefore a computer-aided decision support model is developed to help site engineers with the routine task of allocating space to facilities on the SKA site (see Figure 2).

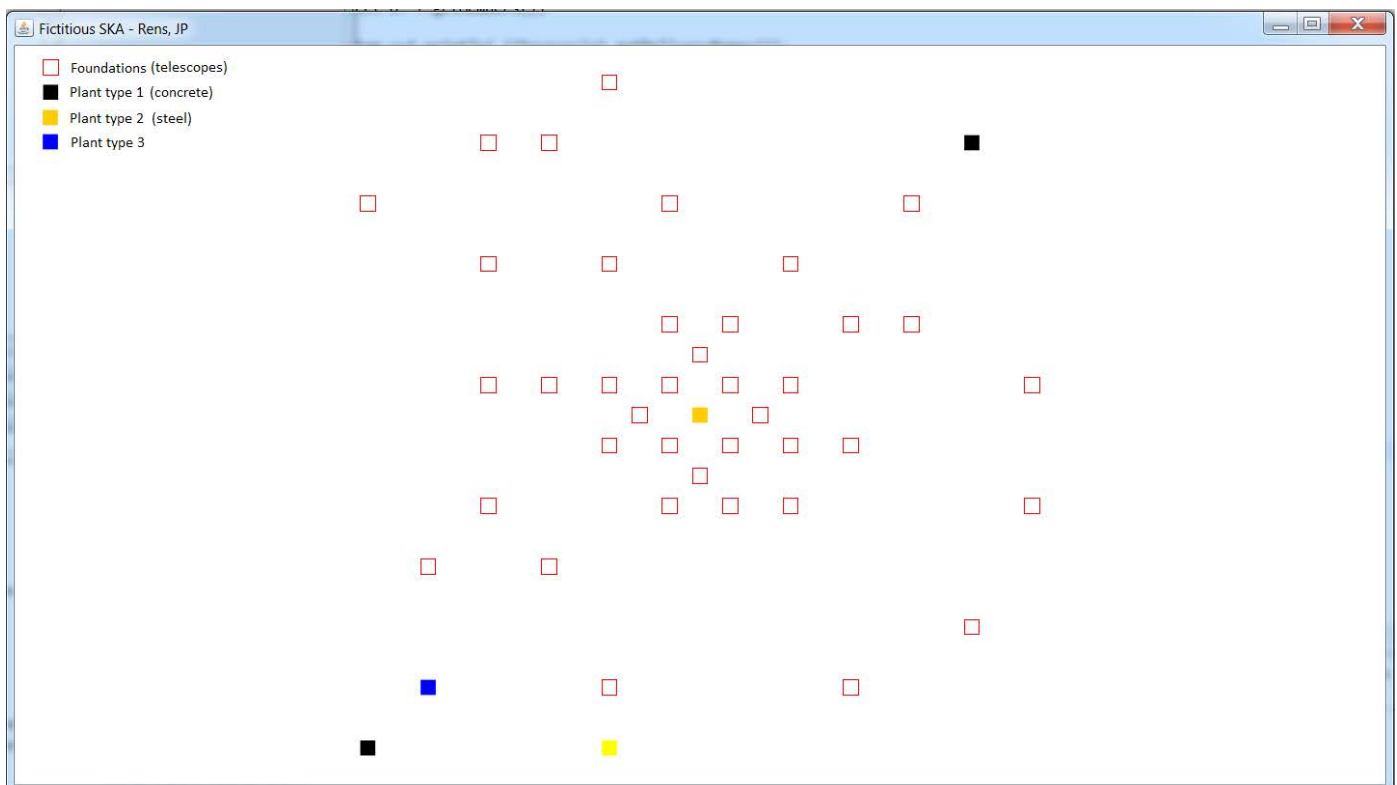


Figure 2: A possible solution to the site layout problem for SKA construction project. Screenshot from author's computer-aided decision support model.

Table 1: Summary of usages of metaheuristics in construction management [1].

Topic	SA	TS	ACO	EA/GA	PSO	HS	SFL	Hybrid	More than 1
3. Engineering Design				5					
4. Cost Estimation				3					
5. Planning									
5.1. Site preparation	1								
5.2. Site/floor layout		1	1	9	1			1 ³	
5.3. Site routing				1					
5.4. 1D stocking cutting				2					
5.5. Supply chain/logistics			1	1					
5.6. Equipment selection				3(1)					
6. Scheduling									
6.1. Resource unconstrained	2		3	2					1 ²
6.2. Resource constrained									
6.2.1. Time-cost tradeoff			3(3)	12(8)		1(1)	1		
6.2.2. Resource allocation			2(1)	8(3)	2(1)				
6.2.3. Resource leveling	1			3					
6.2.4. Integrated models				5(2)					
7. Monitoring and Control				1					

Note: Numbers in parenthesis indicate number of papers that consider multiple objectives. 2 - This study employs two metaheuristics, *i.e.* SA and TS. 3 - This is a ant-GA hybrid. Simulated annealing (SA), ant colony optimization (ACO), evolutionary algorithm (EA), genetic algorithm (GA), particle swarm optimization (PSO), and shuffled frog-leaping (SFL).

A number of studies have been conducted to develop effective site layout models and to improve site layout planning in construction projects. These models utilise different kinds of optimisation techniques and sophisticated algorithms to find optimal solutions amongst a large set of candidate solutions.

Site layout planning can be distinguished as either a static problem or a dynamic problem, depending upon whether non-changing or changing site facilities and site space are considered during different phases of the project. Site layout planning problems can be split up into two types, those with or without predetermined locations [1].

Typically, construction site layout involves the arrangement of a set of predetermined facilities on a set of predetermined candidate sites, while satisfying a set of layout constraints and optimising a collection of layout objectives [5]. If, for example, n number facilities are considered, the number of possible alternatives (that is the number of feasible configurations) is $n!$. This can become a large number, even for relatively small values of n . For example, if $n=10$, then the number of possible alternatives is over 3 628 000 and for $n=15$ facilities, there are already a 12-digit number of possible alternatives.

Static site layout models produce a single site layout with static locations for all temporary facilities in the project. These static locations do not change over the project duration. Dynamic models are more challenging since they include the relocation of temporary facilities on site over the different construction stages and as consequence require more sophisticated algorithms to solve.

Good site layouts must meet multiple, though often conflicting objectives [4]. For example, reducing travel time on site may increase congestion. Construction managers must therefore make decisions in pursuit of these objectives in order for the project to be successfully completed.

Transportation model

The transportation problem describes the situation where a commodity has goods in a number of depots which have to be distributed to customers at various locations. The objective is to find a minimum cost plan for transporting the commodity from a number of sources to a number of destinations. In the construction industry the delivery of concrete aggregates and bricks from various sources to different sites are typical examples of problems which can be tackled by solving the transportation model [6].

Repetitive resource scheduling

Due to the nature of the project, the SKA project falls within the range of projects which consist of repetitive sequences of operations. In such cases the individual activities must be properly synchronised in duration and productivity if gross delays and misuse of resources are to be avoided. It is often this resource continuity requirement that establishes activity starting times and determines the overall project duration [7]. In particular, the construction of the SKA antenna foundations require scheduling of the sort that will maintain uninterrupted utilisation of resources (work teams, equipment, *etc.*). In this study the construction of foundations are repetitive units that require the same set of work processes to be completed.

A repetitive project planning model was developed for the SKA project and integrated with its site layout planning model. This scheduling model determines activity starting times in order to insure that there are no resource interruptions (similar to Figure 4). Construction managers can interact with the model, considering different trade-offs and viewing the implications of their deployment strategies.

Room for optimisation

Although the transportation model and the repetitive scheduling problem calls for the use of optimisation techniques, most of the work described here involves simulation techniques (what if scenario planning for managers).

With the framework set up, it would be very interesting to have further work add optimisation tools to this model framework. Table 1 summarises various metaheuristics that have been applied to study various project and construction management topics. Please feel free to contact authors for any further queries.

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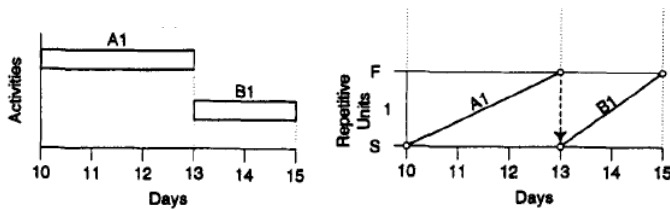


Figure 3: Converting a conventional Gantt chart (left) to the repetitive scheduling method representation (right), represented in Figure 4.

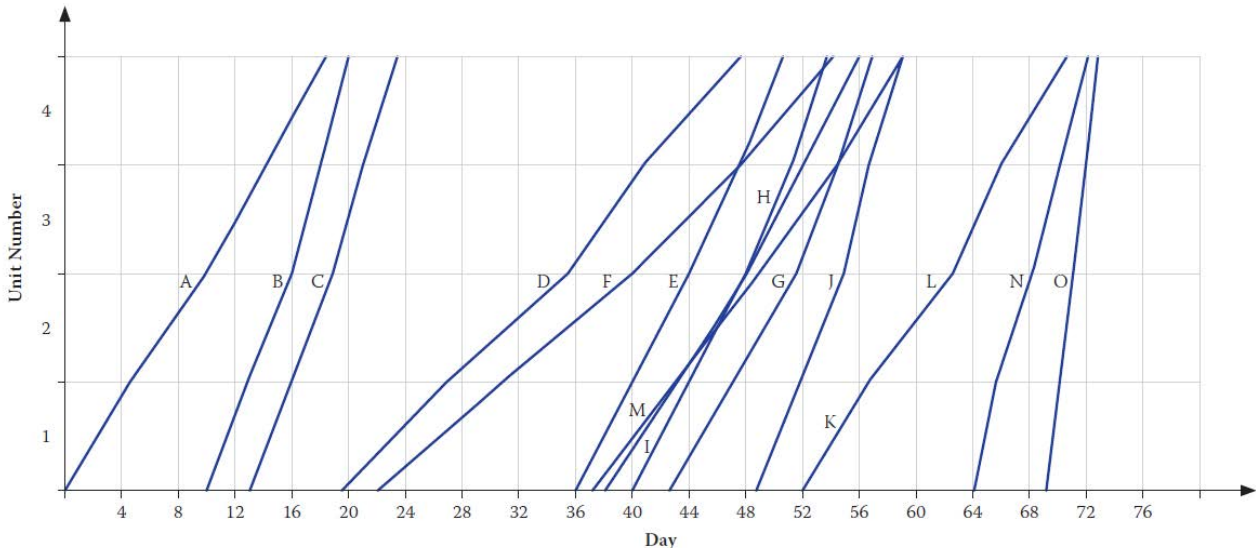


Figure 4: Example of Linear schedule graph of example application [3]. The SKA project will similarly have a set of activities that have to be scheduled according to the repetitive resource scheduling problem.

**THE 6TH OPERATIONAL RESEARCH PRACTICE
 IN AFRICA CONFERENCE: ALGIERS, ALGERIA**

by Sheetal Silal, University of Cape Town (sheetal.silal@uct.ac.za)
 and Hans Ittmann, University of Johannesburg (hittmann01@gmail.com)

The 6th Operational Research Practice in Africa (ORPA) Conference was held at the University of Sciences and Technology Houari Boumedienne (USTHB), in Algiers (Algeria), during the period April 20-22, 2015. IFORS supported the conference through its speakers Hans Ittmann, from the University of Johannesburg, and Sheetal Silal, from the University of Cape Town. ORPA is an initiative aimed at promoting the use of operations research in Africa through both academic and application lenses. With the support of IFORS and EURO, the first ORPA conference took place in 2005 in

Ouagadougou, Burkina Faso. This was followed by conferences in London, Cape Town, Washington and Dakar. In 2015, more than 70 participants, from Algeria, France, Tunisia, Mali, Senegal, Oman and Jordan attended the conference to listen to more than 50 presentations covering a wide range of topics, including genetic algorithms and metaheuristics, topics in combinatorics (such as Bell and Stirling numbers), new heuristic methods for transportation networks and land-use problems, mixed integer linear programming models for the North Atlantic Aircraft Trajectory Planning, a game-based algorithm assigning selfish

users on a road network, graph theory, combinatorial optimisation and stochastic programming.

Though French was the most widely spoken language at the conference, many gave their presentations in English, and the universal language of mathematics allowed for presentations to be followed easily despite other language barriers. Hans Ittmann presented two plenary talks entitled *Freight Transport Planning and Modelling - Its Application within a Rail Environment* and *City Logistics and Urban Freight Transport Challenges in Developing Countries*, highlighting the importance of the planning process in long-term forecasting and the systemic thinking required to overcome transport challenges in the future. This led to discussions on the methods underlying transport models and innovative solutions currently in place in other parts of the world. Sheetal Silal presented a talk on *Hitting a Moving Target: Analysing Epidemiology using Operational Research*, which focussed on methods like differential equation modelling and agent-based simulation to capture the transmission dynamics of diseases such as malaria, Ebola and HIV/Aids. Though not one of the more typical areas of OR application, there was general discussion on capturing disease pathways and human behaviour using mathematics and even enquiries into the possibility of applying such mathematical models to the problem of scorpion stings in Algeria. A Doctoral School Programme was also attached to the conference, covering topics on graph theory, combinatorial optimisation, and transport and logistics.

At the end of the conference, during the closing session, two Best Paper Awards were made. The Best Student Paper Award went to Karim Amrouche from the Faculty of Economics and Management Science of the University of Algiers for his paper titled *Complexity Results of a Chain Reentrante Shop with an Exact Time Lag*. The recipient of the Best Paper Award was Amar Oukil from the Department of Operations Management and Business Statistics of the Sultan Qaboos University in Oman. His very in-

teresting presentation was titled *Inverse Optimization, an Efficient Tool for Resource Reallocation: Application in the Farming Sector*.

There was time for a drive around the Bay of Algiers to see the modern part of the city built along the Mediterranean seashore, and the ancient city of the Deys, crowned by the Casbah or citadel atop a steep hill. We were treated to a



Conference banner

walking tour along the picturesque lanes and houses of the Casbah where we could partake in the local architecture, artwork and stunning views of the city and bay.

The driving forces of conference were Serigne Gueye, originally from Senegal but currently at the University of Avignon, France, and Mohamed El-Amine Chergui of USTHB in Algeria. They, along with organising and programme committee, must be thanked for a well-organized conference. The real reason behind the success of the conference was the engaging nature and high skills level of the students who attended. Their interest in Operations Research and confidence in their abilities, particularly those brave enough to present their research in English, is worthy of praise and made this conference well worth attending.



Serigne Gueye, Hans Ittmann, Mohamed El-Amine Chergui and Sheetal Silal



Best Paper Award Winners: Karim Amrouche and Amar Oukil



44th Annual ORSSA Conference

13–16 September 2015

An advanced warm welcome to the 44th Annual Conference of the *Operations Research Society of South Africa* (ORSSA). The conference will be hosted by the Johannesburg Chapter of ORSSA, and held at Pecan Manor in the Hartbeespoort valley during the period 13-16 September 2015. The theme of the conference is **Future Analytics**.

The conference will open with an optional tutorial on the Sunday afternoon and a welcome reception on the Sunday evening (September 13th) and will close at lunchtime on the Wednesday (September 16th). Participation over the full spectrum of Operations Research is encouraged, including papers of a more fundamental nature, those on the application of Operations Research techniques in business and industry, about topical issues in Operations Research, and about the philosophy, teaching and marketing of Operations Research.

The conference keynote speakers will be Mike Trick and Russ Taylor.



Mike Trick



Russ Taylor



Pecan Manor

Following the successful introduction of published conference proceedings in 2011, authors will again have the choice of either (a) only presenting papers orally at the conference, or (b) submitting full papers (which will also be presented orally at the conference) for inclusion in the peer-reviewed conference proceedings. Registration, and submissions of abstracts and full papers opened on the **16th of March 2015**.

Delegates are responsible for their own travel and accommodation arrangements. Pecan Manor and her sister lodge, Green Leaves, are recommended, as the Society has arranged competitive rates for delegate at these venues.

Pecan Manor – <http://www.pecanmanor.co.za/>

Green Leaves – <http://www.greenleaves.co.za/>

Important Dates

16 March 2015	Early bird registration & abstract/paper submission opens
10 April 2015	Abstract submission closes for reviewed papers
17 April 2015	Notification of acceptance of abstracts of reviewed papers and go-ahead to submit full papers for peer-review
15 May 2015	Submission of full papers for inclusion in the conference proceedings closes
10 July 2015	Abstract submission closes for oral presentation of all papers
17 July 2015	Notification of abstract acceptance for non-reviewed papers
17 July 2015	Notification of acceptance of reviewed papers for proceedings
24 July 2015	Early bird registration closes
14 August 2015	Cut-off for qualification of reduced room rates at the hotel
21 August 2015	Registration closes

Please visit the ORSSA website and click on the link *ORSSA 2015* for more information:

www.orssa.org.za



27th European Conference on Operational Research

12–15 July 2015
University of Strathclyde



Making An Impact: EURO2015 for practitioners



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- See case studies showcasing important applications
- Exchange ideas and expertise with people working in similar areas
- Meet leading academics and discover what they can do for you – and what you can do for them
- Build your network amongst likeminded professionals

Workshops, seminars and tutorials:

- tasters and master classes across the range of practical OR methods including data science, visualisation and analytics, non-linear modelling and optimisation, agent-based modelling,
- workshops and discussions on skills and issues such as career development, design thinking, consultancy skills, quality assuring your models;
- vendor-led sessions (also known as 'The Vendor Stream') on specific software.



University of Strathclyde

Case studies in O.R. and analytics: presentations of case studies, providing learning and inspiration for your own practice. In addition, streams such as Health, Defence and Security, Civil Government, Strategy, Finance and many more will include practical case studies within particular practice areas or methodologies.

Academic-practitioner bazaars: posters and 60-second presentations highlighting the latest developments across the academic-practitioner interface.

Bridging the academic-practitioner divide: posters, 60-second presentations and round-table discussions aimed at highlighting the latest developments and developing successful partnerships.

European Excellence in Practice Awards (EEPA): outstanding examples of O.R. applications, competing to win this prestigious award.

Speed networking: a fun and focused session to help you make new contacts across the O.R. spectrum.

Mentoring clinic: one-to-one mentoring sessions with experienced practitioners: get valuable advice, develop your knowledge and skills, gain new perspectives and expand your network.

Keynote: Professor Michael Trick, guru, academic, consultant, and President Designate of IFORS, will be discussing the key trends that are affecting the world of Operational Research.

Cost: £560 inc VAT for three days including university accommodation and meals.

If you would like to get involved, by presenting a poster, running a workshop or requesting a workshop, please contact Ruth Kaufman via MAI-EURO@theorsociety.com

For more details, go to www.euro2015.org/MAI or email MAI-EURO@theorsociety.com

MAKING AN IMPACT: EURO2015 FOR PRACTITIONERS

by Ruth Kaufman, Department of Management, London School of Economics (r.a.kaufman@lse.ac.uk)

You have to offer something exceptional in a conference to persuade practitioners to leave their desks and deadlines; and that's what we're doing this year at EURO2015. We have a wealth of activities aimed at helping practitioners become more effective:

- The ever-popular *Bazaar* — posters and 60-second presentations highlighting the latest developments across the academic-practitioner interface — already has posters covering a multitude of application areas, including personalised healthcare, rostering shiftworkers, credit risk of SMEs, new optimisation methods. It's not too late to contribute: if you are a practitioner with something you would quite like an academic to help with, or an academic with something you want practitioner involvement with, or if you have an example of successful ac-prac collaboration to share, please contact us at MAI-EURO@theorsociety.com to book a space at the Bazaar.
- A selection of workshops spanning the full breadth of practitioner-oriented issues, from honing your CV to finally getting to grips with non-linear optimisation, via consultancy skills, soft OR, data science, and all points between. We are delighted with the calibre and variety of people scheduled to run workshops, seminars and tutorials. For the full current list, go to www.euro2015.org/MAI and follow the workshop link
- A keynote speech from Professor Mike Trick. Older readers will remember "Michael Trick's OR page" as the source of information in the pre-Google dark ages. Mike is an eminent professor, practising consultant, and President Designate of IFORS; he will be discuss-

ing the key trends affecting the world of Operational Research

- Speed networking: your chance to find out who is out there and what are they doing, and to let them find out about you.

New this year, we are running mentoring sessions. Mentors will be asked to provide a short profile, so that delegates can actively choose a mentor and book a 15-20 minute slot in advance. If you are reading this electronically, click here if you'd like some mentoring and here if you think you'd make a good mentor; for hard-copy readers, go to www.euro2015.org/MAI and follow the links. If you are coming to the conference and would like to volunteer an hour of your time as a mentor, please get in touch at MAI-EURO@theorsociety.com. Otherwise, keep an eye out for details of how to take part as we get closer to the conference date.

All this is on top of the full scientific programme of presentations with over 100 streams including many areas of interest to practitioners; vendor presentations and exhibits; social events; and invited plenaries. So – plenty of reasons to leave that desk and deadline behind for a couple of days, and join us in Glasgow, 12th-15th July. If you haven't already booked, do book now via www.euro2015.org. And whether or not you can come yourself, please spread the word amongst colleagues and friends and help make this one of the most successful conferences ever.



Follow us on Twitter at @euroconf2015 and @TheORSociety



Networking (UK OR55-2013)



Academic Practitioner (2014)



Speed Networking (UK OR56-2014)



Academic Practitioner (2014)



Speed networking (2013)

TRIBUTE TO PROFESSOR HEINER MÜLLER-MERBACH 1936-2015 (IFORS PRESIDENT 1983-1985)

by Theo Stewart, University of Cape Town (theodor.stewart@uct.ac.za)

To long-standing members of ORSSA, it was with deep sadness that we learnt of the passing of Heiner Müller-Merbach on 30 May 2015. He was a great friend of ORSSA, and in fact was a Life-Member of the Society. The record shows that he was one of a long line of distinguished presidents of IFORS, but this bald fact does not reflect the immense impact he had on IFORS and the profession of OR. For decades, he was a dynamic presence at IFORS conferences and he served as member of various influential committees. He was a deep-thinking philosopher on the role and practice of OR, while at the same time deeply sensitive to individual needs. At each IFORS conference he would be the one recognizing absences of friends and organizing cards of greetings to them.

To ORSSA in particular he was a close friend. I first got to know him in 1979 (if I remember correctly), when he visited South Africa as a guest of ORSSA, and I had the privilege of accompanying him and his then wife Uta on a trip to the Kruger Park. During his presidential term of office, at a time when political affairs were leading to increasing isolation of ORSSA from the world community, he encouraged and supported the holding of the “International Conference on Operations Research in Resources and Requirements in Southern Africa”, held at the CSIR conference Centre in Pretoria, 2-5 April 1984 with IFORS sponsorship. He attended the conference and delivered a paper on “Resource Planning Model Design based on

an Extended Structured Systems Approach”, in which he warned of the dangers of forgetting ethical and aesthetic values in planning when they are not representable in formal models. When IFORS adopted a regional structure which rather left ORSSA out on a limb, it was Heiner who facilitated the contacts which led eventually to our acceptance as a member of EURO.

It is perhaps fitting that the last of the IFORS triennial conferences that he was able to attend was that hosted by ORSSA in Sandton, 2008.

During his presidential term, he composed a regular series of letters to the IFORS community. Some of these reported on activities of IFORS, but many reflected philosophically on the role of OR theory and practice, and its links with other disciplines. Such was their impact that the European Journal of Operational Research collated them into an article (Vol 25, 1986, pp.421-447). Many of these letters are pertinent today! The letter of June 1983, on marketing operational research, could well be relevant to deliberations of the current executive committee.

Heiner, dear friend, those who knew you were enriched by that association, and you will live on with us. I can do no better than to repeat the closing words from the tribute on the IFORS web site: “the brilliant and caring mind that is behind the friendly and jovial man”.



Heiner Müller-Merbach (left) meeting with other presidents of IFORS at the 2008 IFORS Triennial Conference in Sandton

MOVIE REVIEW: MONEYBALL

by Brian van Vuuren, Department of Industrial Engineering, Stellenbosch University (16057651@sun.ac.za)



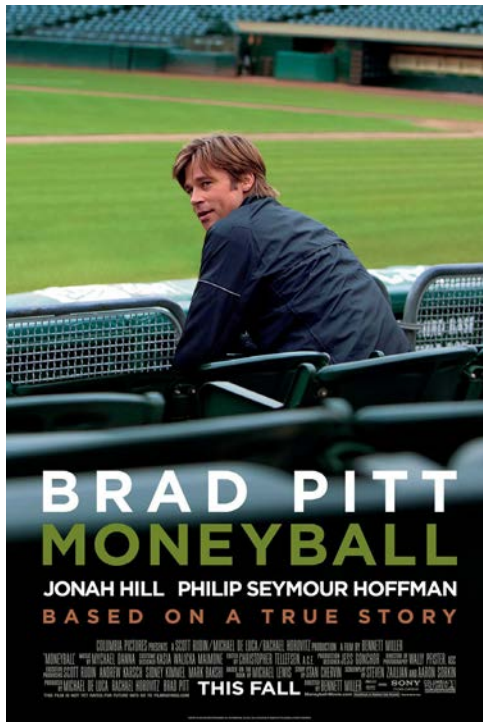
Brian van Vuuren

In 2002, Oakland Athletics, the lowest-salaried major league baseball team in the United States set a new American League record, stringing together a 20-game winning streak after beginning the season with 11 consecutive losses.

Billy Beane (Brad Pitt) is the main character and general manager of Oakland Athletics.

An old MLB player himself driven by his hatred of defeat, Beane had taken the A's to the world series in his previous season, only to have their three best players poached by richer teams offering bigger salaries.

Faced with the task of reconstructing a team with empty pockets, Beane crosses paths with Peter Brand (Jonah Hill) — a fresh output of Yale who crunches numbers to arrive at a strict cost-benefit analysis of baseball players. He persuades Beane that he should hire players based on key performance statistics that point to undervalued players, helping the duo assemble a team that, through a difficult season, prove themselves to be the biggest bargain in baseball.



ing some soul-baring moments for Beane as he attempts to make sense of his purpose and position in life and in the team, as well as the constant reality check of the fact that, at the end of the day, baseball is business and players are inventory — no matter how much of yourself you invest into something.

In conclusion, perhaps a moment in the film which best resonates with the scientific community, working tirelessly to painfully progress and refine their craft and, essentially,

tread fresh footsteps in the scientific landscape, is the advice given to Beane by John Henry, owner of the high-flying Boston Red Sox:

"I know you've taken it in the teeth out there, but the first guy through the wall – it always gets bloody, always ... but anyone who's not building a team right and rebuilding it using your model, they're dinosaurs."

Ratings:

IMDB: 7.6/10

Rotten Tomatoes: 95%

Metacritic: 87%

Betting against tradition in favour of numerical analysis goes against centuries of baseball history, but demonstrates that a computer can assemble a team better than the finest of human instinct. So much so that, in 2002, the Athletics, with approximately US\$44 million in salaries were competitive with large market teams such as the New York Yankees who spent over US\$125 million in payroll that same season.

Beane's approach to selection includes a number of metrics: when a player is drafted, on-base percentage and slugging percentage, to name but a few. This empirical analysis of baseball, involving statistics which measure in-game activity, is called *sabermetrics* and has become a popular method of attempting to answer objective questions about baseball. The movie had such an impact, in fact, that teams who appear to value the concepts of sabermetrics in the league today are often said to be playing "Moneyball."

All in all, Moneyball is an engaging, insightful film, featur-

Michael Trick (the keynote speaker at this year's ORSSA conference) also wrote a blog about the movie entitled: *Operations Research: The Sort of Decisions That Will Get You Fired.*

SUBMIT A FEATURE ARTICLE

The ORSSA Newsletter is an excellent medium for showcasing one's work to the Operations Research community, not only in South Africa, but around the world. There are zero costs associated with submitting an article to the Newsletter and if selected for publication, the article sets the theme for the entire edition. If you would like to submit an article to the Newsletter, please send your article and all associated media (e.g. images, charts, etc.) to the editor at berndtlindner@gmail.com

BOOK REVIEW: THE ROOTS OF LOGISTICS

by Hans Ittmann, University of Johannesburg (hittmann01@gmail.com)



Hans Ittmann

It is well-known among people working in logistics and supply chain management that this discipline had its origins in the military, which goes back more than a century. French General Antoine-Henri Jomini (1779-1869) is credited with the first documented use of the term *logistique*. In his classic work *The Art of War*, he defined logistics through 18 principal duties, one of which was referred to as the preparation of all material necessary for setting the army in motion.

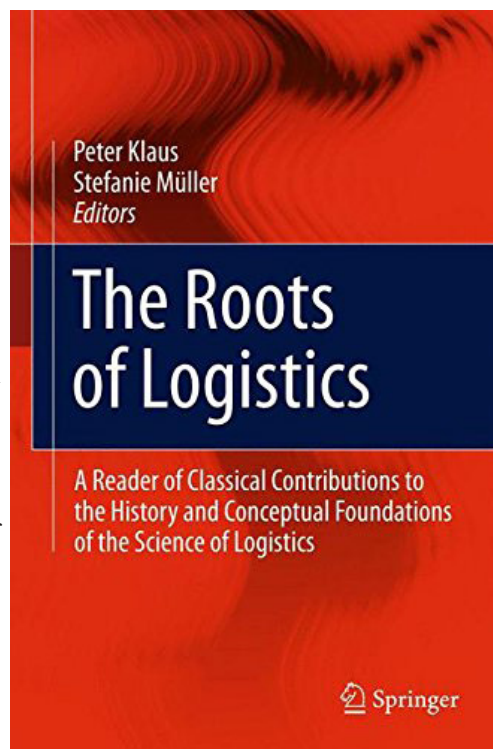
Modern logistics, or supply chain management, which encompasses all the activities within a company or organisation, has become a main function in business. As an important component of managerial practice, it has grown into a powerful industry within countries and in the global market place. Nonetheless, there are still questions in academic circles on whether logistics is a science. Many see logistics as part of, among others, marketing, operations management and operations research. In addition, there is no consensus on its definition, boundaries and essential characteristics. The book *The Roots of Logistics* aims to contribute to this debate by laying down all contributions from a wide spectrum of disciplines along the evolutionary path of the science of logistics.

The book consists of three parts touching on the different aspects of logistics. In all except one, these chapters contain full accounts of excerpts from previously published papers as well as documents from books and scientific journals, some of which are difficult to access. An introductory essay by the editors presents the context of what is covered in the book. For each of the three parts, the editors underline the importance of the chapter, what it contains and their relevance to the development of the concept of logistics. Part one deals with the early history, terminology and conceptual roots of logistics. Part two addresses the evolution of business logistics as an autonomous science. Part three covers the contributions from a collection of disciplines to the “instrumentation of logistics” — terminology, concepts and methodological approaches as we know them today.

Part one consists of two sub-sections. The first sub-section focuses on the early thinking and origins of logistics and how they contributed to war preparations and the task of supplying required resources to the forces on the ground. It set the tone for what was to become more than just military logistics, evidenced by a paper published in 1955 by Oskar Morgenstern, which puts forth the formulation of the *Theory of Logistics*. Then enter researchers who considered the utility of place, time and possession which together represented the utilities of products. Sub-section two includes a number of contributions outlining the emergence of logistics as a discipline and component of marketing. Logistics was the other half of marketing and reference was made to this as matter in motion. At this point, literature started referring to this half of marketing as physical distribution. Marketing logistics was seen as the link between the producers and the consumers. The aim is to make sure that the right product is supplied to customers at the right time and the right place. A paper by Converse (1955), “illustrated the enormous potential for cost reduction in rationalizing physical distribution activities – referring to network optimization, modal choices, logistically optimized packaging, and other levers which today are part of the tool kit of professional logisticians”, thus starting what is currently generally accepted as the discipline of logistics.

As a subset of marketing, there were still challenges of transportation (creating utilities of place), storage and warehousing (creating utilities of time) and sorting, picking/packaging, consolidating, changing the order and arrangement of things (creating utilities of possession) that needed attention.

Part two covers the evolution of logistics as an autonomous field, and is covered in two separate sub-sections. Voigt (1953) focuses on the influence of transportation on industrialization and *vice versa*. Seven factors determining the usability of a transportation system to meet demand were identified, including, among others, network density, speed, frequency, and predictability. Another building block of importance is covered in a paper addressing the generic functions of placing, pricing, and patterning which were extended to include coordination logistics as well as flow systems.



In the sub-section entitled *The Emergence of a Flow Systems Paradigm*, the topics of papers include the scientific fundamentals of organizations, industrial dynamics, the Toyota production system, supply chain management and the importance of time. Forrester (1958) in his seminal paper on industrial dynamics anticipated one of the fundamental premises or principles of modern logistics when he made the following statement in the first paragraph of his paper, “Company success depends on the interaction between the flows of information, materials, money, manpower and capital equipment.” The just-in-time, kanban system, among the concepts from the Toyota way of doing things (Ohno, 1978), revolutionized logistics management and thinking in a big way. Oliver and Webber (1982) were the first to coin the term *supply chain management* viewing the supply chain as one entity — thus realizing that supply is a joint objective of all elements on the chain.

The contributions from the quantitative and engineering sciences are briefly outlined in the initial three chapters (sub-section one) of part three. The piece on the most appropriate location for a logistics facility goes back to the work of the German economist Launhardt in 1882. Operations Research contributions feature strongly in the section on vehicle routing and scheduling between nodes on a network as well as on the integration of production planning issues (e.g. production capacities, optimal inventory levels, scheduling system for a multiple plant/ multiple product, demand seasonalities). A significant number of papers published in OR journals are cited.

In sub-section two of part three, the importance of a production-line approach through manufacturing in the field gives a totally different perspective on how the service

industries should be managed. The initial thinking, components and contributions to current day aspects of risk management and resilient supply chains are covered in this section. In the third sub-section of part three, contributions from economics and organisational sciences are described. This part also highlights various logistics building blocks, such as the nature of a firm, the architecture of complexity, production, consumption and externalities, educational organizations as loosely coupled systems, and markets, bureaucracies and clans.

As an Operations Researcher who has been intimately involved with logistics and supply chain management for many years, I welcomed the opportunity to dig up the roots of this discipline, to understand its history and how various disciplines contributed to it. I was particularly pleased to find the prominent role that operations researchers have played and continue to play in its development. It is heartening to note that prominent OR personalities were part of the scientific community that inspired, informed and added to the concepts and ideas, and provided the building blocks to what is today considered as the science of logistics. The editors of *The Roots of Logistics*, through casting their net very wide in researching the history of this important discipline, were indeed, able to offer “A Reader of Classical Contributions to the History and Conceptual Foundations of the Science of Logistics.”

The Roots of Logistics – A Reader of Classical Contributions to the History and Conceptual Foundations of the Science of Logistics by Peter Klaus and Stefanie Muller (editors), 2012. Springer, Heidelberg, Germany. pp 427, ISBN 978-3-642-27922-5, 129.95 EURO (Hardcopy).

ORSSA JOHANNESBURG CHAPTER EVENT

by Dave Evans (davevans@gmail.com)

On 26th May 2015, Rob Bennetto gave a talk to sixteen people, preceding the Johannesburg Chapter’s AGM, titled *Applied uses of cloud computation for the distributed optimisation of rapid scenario evaluation*.

Cloud computing has matured significantly in recent years with the ease of use, infrastructure, virtualisation and programming interfaces becoming ever more sophisticated.

The talk gave an outline of the process used to solve large-scale optimisation problems quickly under different scenarios, including sensitivity analysis using the Amazon Web Services industrial cloud infrastructure. Rob

explained how they aligned the optimisation task for high-speed solutions of many different cases, and provided key business insights about fleet sizings under varying control parameters for a national supplier of beverages in South Africa.

Rob also indicated how much ‘OR functionality’ is now also on tap in this environment.

It was enlightening to find out how much this technology has developed in recent years, and just what functionality and capacity is now available in the cloud. Many thanks to Rob for an outstanding talk.

Chapter Annual General Meeting

The Joburg Chapter AGM followed the talk. The new Executive Committee for 2015 is:

- Chairman: R Bennetto
- Vice Chairman: J Dean
- Treasurer: D Saunderson
- Secretary: D Evans
- Additional Members: L de Sousa, M Einhorn, B Bothma, D Clark, H Mohaman

The Acting Chairman, John Dean, reported a successful year, with three events: a talk by Ian Campbell, the Val-

entine's dinner, with (as is traditional) a non-OR related (and very entertaining) talk by Paul Fatti on a very hairy climb he did in the Drakensberg mountains, and the above-mentioned talk by Rob Bennetto.

The incoming chairman, Rob Bennetto, emphasised that the focus for the next few months will be the national conference, which is being organised by the Johannesburg Chapter, supported by the Pretoria Chapter.

Dave Evans
Secretary, Johannesburg Chapter

ODE TO KRIGING

by Gerhard Geldenhuys, with thanks to Mr Johan Krige for information on Prof Danie Krige and the Ode

Prof Daniel Gerhardus ("Danie") Krige is recognised internationally for his work in geostatistics. He was the recipient of numerous awards, both locally and overseas, including a DSc (Eng) from Wits in 1963, based on his research papers, and honorary doctorates from the Universities of Pretoria (1981) and South Africa (1996). After obtaining a degree in mining engineering from Wits in 1938 he worked in the mining industry for many years. Of special interest for operations researchers is that Krige's interest in the application of mathematical statistics to ore evaluation was stimulated by research of Dr H S Sichel, who in 1969 became the first President of ORSSA. The importance of Krige's early research papers was recognised by French mining engineers and his method was named "kriging" in his honour. Kriging is applied widely in fields such as mining, rock, environmental and petroleum engineering, hydrology, agriculture and fisheries. On retiring from mining engineering in 1981, Krige was appointed as Professor of Mineral Economics in the Mining Engineering Department of Wits. He occupied this chair

until 1991. He passed away in 2013 in the age of 93 years. The following sonnet, "Ode to Kriging", was written in May 2012 by a subset of students in the Vadose Zone Hydrology course CE 202A at UC Berkeley, USA:

*I like to kriging the whole day through
make estimates that are brand new.*

*Hydrologists have attitude
estimators, exactitude.*

Ack heterogeneity!

No worries, stationarity!

*Covariance has potential:
gaussian or exponential?*

*Least square guesses are moronic
kriging works on fields ergodic.*

*Covariance, we like to say,
makes all your troubles go away.*

So, if you're lost in 202

we hope these lines will see you through!



Prof. Danie Krige



Prof. Danie Krige receiving the National Order of the Baobab award from the president of South Africa, Jacob Zuma (2012).



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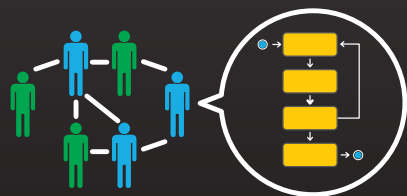
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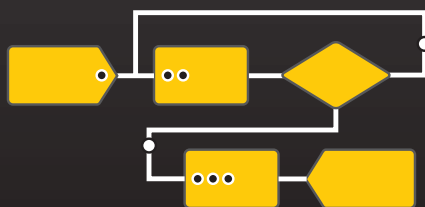
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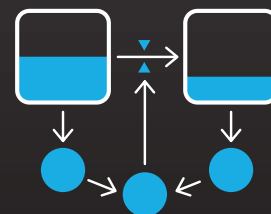
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