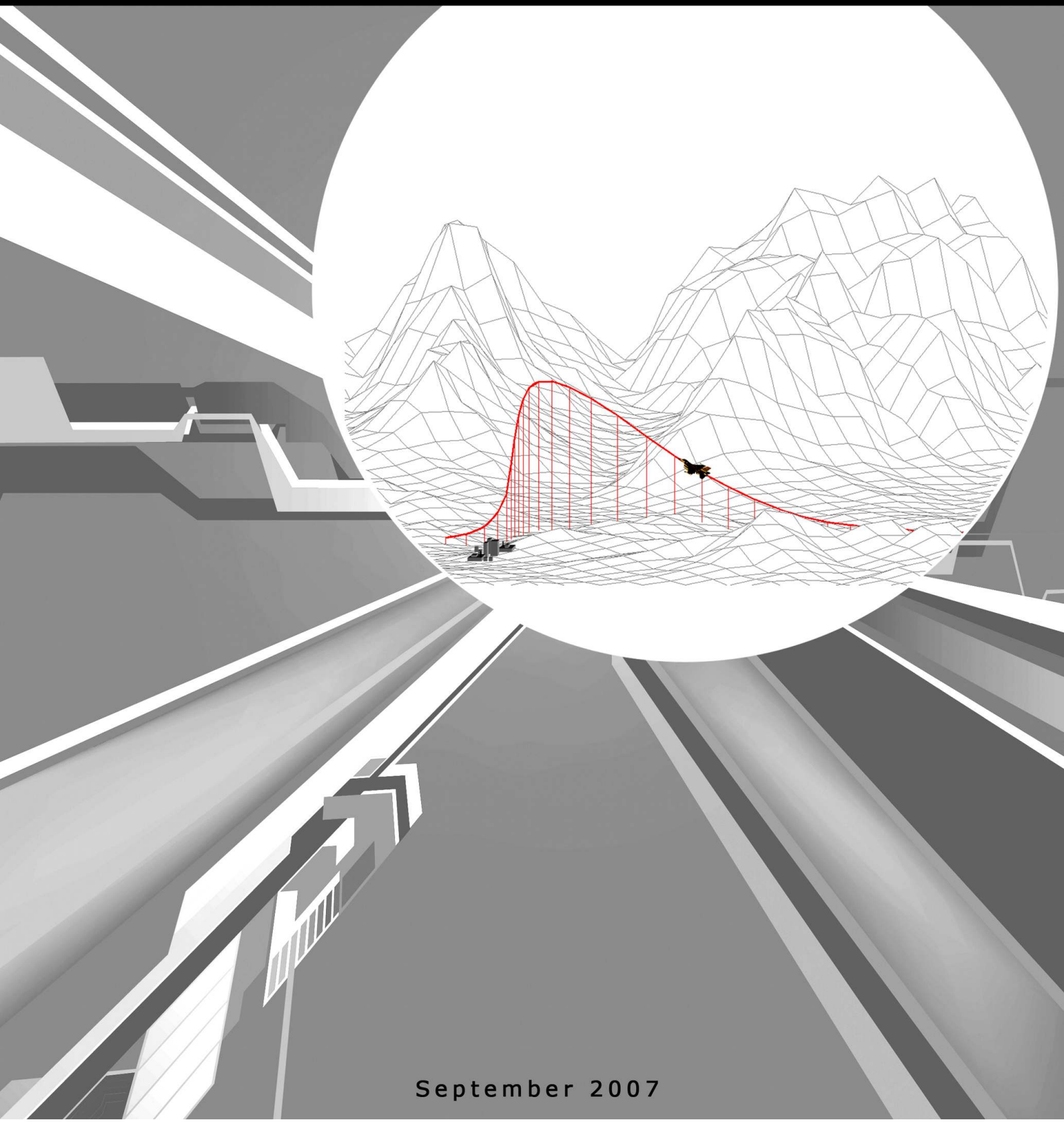
Newsletter

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



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FROM THE EDITOR

Basie Kok

Welcome to the 3rd edition of the ORSSA newsletter 2007! I'm sure many of you are in the final lap of wrapping things up towards the end of the year, but if you would like a refreshing read to escape from the looming deadlines for a while, then take a few moments to page through some of the OR happenings from around the country and take a look at some of the fascinating work being done by our members.

I am sure many of you still have the recent ORSSA conference 2007 fresh in your memories and you will be delighted to know that I received two excellent accounts of the event from Darian Raad and Theo Stewart.

Our main article for this issue is written by a team of researchers from the University of Stellenbosch entitled *Project TEWA*, and showcases a large project involving the research and development of a Threat Evaluation and Weapon Assignment (TEWA) decision support system for the South African military. Some interesting applications of OR related work are described here, again demonstrating the immense scope and flexibility of the field.

A word from our president, Marthi Harmse, will be sure to make you consider yourself and your profession in a different light and our member profile from Paul Hector gives some fascinating insights into OR, specifically within an African context.

I hope you enjoy the issue!

Features

International Federation of Operational Research Societies (IFORS) Conference
13-18 July 2008
Sandton Convention Center, Johannesburg

Operational Research: Developing communities, managing the connections amongst them.

Abstract submissions deadline : 15 December 2007
Supersaver Registration : 1 July 2007 - 29 Feb 2008
Early Registration : 1 March - 30 April 2008
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Student Registration : 1 July 2007 - 30 June 2008

http://www.ifors2008.org

FROM THE PRESIDENT'S DESK

by Marthi Harmse (marthi.harmse@sasol.com)
ORSSA President

Marthi Harmse

Dear ORSSA friends,

During the Extended Council meeting of the Association of European Operational Research Societies (EURO) in Prague on Sunday 8 July 2007, the current EURO president, Martine Labbé, chaired a discussion on opportunities for EURO in the future with specific reference to strengths and weaknesses of Operations Research. This proved to me once again that Operations Research is well and alive since reflection and development to me is characteristic of Operations Research. Even before Sir Robert Watson-Watt named a certain type of scientific activity Operational Research for the first time in the late 1930s, Operations Research has been subjected to such a process of reflection and development.

I also experienced a good dose of reflection and development at our recent annual conference which was joined for the first time with the conference of Operations Research Practice in Africa (ORPA). The conference also coincided with the first ORPA / INFORMS Workshop on OR Education. In the presidential address at the opening of the conference, I posed the question whether Operations Researchers could be regarded as rebels and martyrs, tormented by the reflection and development they continuously engage themselves with – similar to artists in the nineteenth century as portrayed at an exhibition at the National Gallery on 28 June to 28 August 2006. As with the artists in the nineteenth century (and before and after), I believe that we as Operations Researchers are responsible for the image that the spectators have of our practices.

Do we portray ourselves as heroes of the establishment, romantic, mythical or bohemian heroes, dandies and flâneurs, or as priests, seers, martyrs and Christ-like figures? If I could become a viewer, which I cannot, of the collage painted by the participants of our recent conference, it would be of tabu, annealing, genetic and fuzzy African nobles, travelling along rural roads and high ways, hanging out at wine cellars, diamond mines, refineries, spaza shops, fuelling stations, photovoltaic power stations, nuclear power plants, blood banks and many other properties, while retrieving information to manage resources, supply chains, manufacturing, inventory, electricity, coal, banks and finances, schedule production, score credit, evaluate threats and assign weapons, serve the public, communities and NGOs across digital divides, measure and alleviate poverty and offer free primary education and many other forms of it. Of militants, activists, detectives and artists of distinction in a long line of great masters such as Cecil John Rhodes, Tom Rozwadowski and Pat Rivett.

Could we then be regarded as God-like figures who can address all the problem situations in the world? I do not believe so. I believe that not one single Operations Researcher is multi-talented enough to be able to address to the full extent even some of the simple problem situations of our great and wonderful world which we helped create. I do not believe that one single Operations Researcher has such a pure heart and such wisdom that he or she could address problem situations to the greater benefit of all involved at all times.

I do believe, however, that Operations Researchers could be the cows who chase away the dogs from the haystack as referred to by the Statistician General of South Africa, Pali Lehohla. Let us accept the challenge anew to create a truthful and inspiring image of the South African Operations Researcher, display our works at exhibitions, and invite others to come and view our works of art.

Marthi Harmse

QUERIES AND CONTRIBUTIONS

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Contributions and other forms of communication with the editor can also be conducted from the website at: **www.orssa.org.za**.

AMENDMENT NOTICE

The newsletter team would like to apologise for incorrectly indicating the author of the article entitled "*Sampling for Scorecard Robustness*" in the June 2007 edition as Margarete Bester when, in fact, the author was David Coleman. The error was a result of a miscommunication between Margarete Bester who submitted the article, and myself, the editor, who assumed the submission was made by the author. Margarete Bester never indicated that she was the author of the piece.

Full credit should be given to David Coleman for an excellent piece of work and we will do our best to ensure that this sort of thing does not happen again.

We would like to thank all our contributors for your continued support of the newsletter and the exceptional quality of the pieces you submit. We would like to encourage further submissions from any ORSSA members or any other OR related work that any reader thinks would make an interesting feature in this publication.

MEMBER PROFILE: PAUL HECTOR

by Basie Kok (bkok@dip.sun.ac.za)

Paul Hector

Paul Hector joined ORSSA nearly two years ago and I came into contact with him for the first time at this year's annual ORSSA conference. He completed a Bachelor of Science in Civil Engineering (Honours) at the University of the Western Indies in 1994 and went on to complete a Master of Science in Civil Engineering at the University of Washington in 1997. He followed a series of courses on intellectual property rights in Geneva, Switzerland from 2002 – 2005 and is currently pursuing postgraduate studies in Operations Research through the University of Strathclyde in Glasgow, Scotland.

Paul has been involved in teaching secondary school physics, integrated science and mathematics, has been a practicing Civil Engineer for more than 6 years and has more recently taken up a position with UNESCO in Addis Ababa, Ethiopia as UNESCO's Advisor for Communication and Information (CI) in the Horn of Africa with responsibility for implementing UNESCO's CI Programme.

Over the past 16 years Paul has been engaged in roles of increasing responsibility in public, private and international organizations across a range of countries and cultural settings. These experiences have given Paul unique analytical, managerial, leadership and interpersonal skills. His persistence, multi-disciplinary outlook, adaptability and initiative coupled with his ability to learn quickly and build on past experiences and training, allows him to function effectively across a range of demanding applications. He is a valuable asset to ORSSA and the OR profession as a whole.

How did you become involved/hear about OR and what attracted you to it?

My background is in Engineering (Structures / geotechnics) so I have been aware of and used optimization, project planning, expert systems, modelling and other OR planning tools. More recently I decided to broaden my skill set further by doing another Masters. OR was a logical choice as it allowed me to build on my existing academic/practical knowledge as well as provide a range of multidisciplinary problem-solving tools that are applicable in my current work environment. It is also of course opens up a range of other career path opportunities.

Do you think OR can be beneficial to your type of work and in what way?

As I mentioned, my formal training is in engineering and I previously worked for 7 years on several internationally funded marine and civil engineering projects before entering the UN. Over the past almost 7 years I've built up "expertise" through a combination of training and practice in solving problems across a number of areas such as using Information and Communication Technologies (ICT) to address human development challenges (literacy, multilingualism, social inclusion, entrepreneurship, *etc.*), working in multicultural public-private-NGO teams, supporting knowledge/ experience transfer across often very different countries, intellectual property rights, supporting national and international policy development. In all of this work we constantly face the challenges of prioritizing resources (time, money, personnel), balancing seemingly conflicting objectives amongst stakeholders, developing strategies and measuring progress/performance. I think OR offers a range of "hard" and "soft" tools and frameworks that can help us to better understand these situations and then make appropriate/objective decisions.

At the recent ORPA/ORSSA 2007 conference, which you attended, a fair amount of discussion about the role of OR in Africa took place. Having had experience in systems implementation in Africa from a humanitarian perspective, where do you think the biggest challenges for OR practitioners in Africa lie?

Very often it is easy to categorize the human development challenges that we are seeking to address (for example, increasing primary school enrolment, improving literacy, reducing conflict, increasing respect for human rights, reducing environmental degradation) as separate activities when they are all, in fact, interconnected. It is also difficult to bring together the various actors with relevant expertise, information and resources in the right sequence/timing and have them work together. The end goal of development activities is improved socio-economic conditions but too often we forget that some of the supporting pillars take long periods of sustained efforts before we can observe the benefits and may require profound changes in peoples' mindsets and beliefs. For example the benefits of increasing primary school enrolment from 50% to 85% on socioeconomic development may not be visible for perhaps 10 or even more years, and if other efforts to improve school sanitation, carry out inoculation to control diseases, ensure sufficient trained teachers etc are not done we still don't achieve the results we are seeking. So ensuring sustained actions, coordinating stakeholders, changing mindsets and patience I think are amongst the biggest challenges.

You work for the United Nations Educational, Scientific and Cultural Organisation (UNESCO). In your experience does the UN, and other aid organisations often use a scientific approach to project planning and demand analysis, or do timeline constraints and implementation challenges often make this difficult?

A lot of planning often goes into projects but there is always room for improvement and we need to bear in mind that projects can vary considerably and are often unique. For example, as part of the global Education for All (EFA) initiative and Literacy Decade UNESCO is working with a number of actors to build capacity, support policy development and implementation, assess resources, improve data collection systems and a range of other improvements which are regularly assessed against measurable benchmarks. On the other hand, a short duration emergency education support to a post-conflict or post-disaster area would

probably not afford the same depth of prior planning and progress monitoring.

While initiatives are sometimes conceptualized globally they need to be translated into local actions which are socially, culturally, economically, technically relevant/feasible. Dialogue with beneficiaries to build trust, project ownership, address local needs, concerns, priorities and constraints takes time, but is essential, and often success may look very different from what was initially planned or envisaged. Building local human and institutional capacity can take a long time and often cultural, language and other barriers need to be overcome. Also, the ones who may perhaps most benefit from these initiatives are the ones who are most discriminated against, most vulnerable, least involved in decision-making and hardest to reach.

One very positive sign though are the many efforts to document "best practices" and incorporate these in future work as well as fostering the building of national, regional and international e-mail networks or communities of practitioners where experience and learning can be shared.

What role do you think societies such as ORSSA can play in bridging the gap specifically between mainstream NGO aid organizations and OR professionals and academics?

Many organizations don't realize that there are methods that can help them to model, improve their understanding of situations, make changes/assess and improve what they are doing. At the same time many organizations are also using OR-derived tools and methodology in such areas as performance measurement, but are not aware of their OR connections!!

OR is well known in manufacturing and the military; Perhaps by showing how OR has proven successful in these fields and then drawing parallels/similarities with activities being carried out by aid organizations, we can then foster their uptake. For example the whole process of delivering food and medical supplies to street orphans could be modelled as a supply chain.

Many of the problems in humanitarian work require actors at a number of levels, sometimes with conflicting interests, different time horizons, perceptions and motivations to work together to achieve some end result. These give rise to complicated interactions and present a rich and interesting set of problems both practically and from a research point of view where OR societies can get involved and show their relevance.

Have you experienced or been involved in a successful OR related project recently?

I guess I am increasingly drawing on different parts of OR in my work, especially as I am now studying in this area. I don't have a success story yet, but in the coming months I'll have one to share with you.

Evidently there is an enormous potential for OR to help streamline systems in Africa. What message would you like to send to OR practitioners, as well as industry and multi-nationals like the UN, in order to fulfil this potential?

I think you know that old question "if a tree falls in the forest, does it make a sound?" So, I guess we need to find ways to let more persons know about OR. The proof of the pudding is in the eating, and nothing works better, I think, than demonstrated success so I guess we need to look at building closer links with the media to showcase our work. There are local governments, UN agencies in various countries, private sector entities interested in various types of social projects in a range of initiatives such as water resources, distribution of anti-retrovirals, education, emergency relief, policy reform ….where OR can be applied. Perhaps OR Societies need to take the initiative and approach these bodies and ask to be involved. Universities offering OR should perhaps also seek to develop a closer link between theory and application. I'm sure though we all know this, we just have to find ways to do it.

Project TEWA

"*Thus I found, in the secrets of the art, additional resources which served me instead of the 100,000 men of which I was short*"- **Napoleon Bonaparte (1769-1821)**

Introduction

In a military environment an air defence (AD) operator is required to evaluate the tactical situation in real-time and protect defended assets (DAs) against aerial threats by assigning available weapon systems to engage enemy aircraft. Since this aerial environment requires rapid operational planning and decision making in stress situations, the associated responsibilities are typically divided between a number of operators and computerized systems that aid these operators during the decision making processes. One such a decision support system, a *threat evaluation* and *weapon assignment* (TEWA) system, assigns threat values to aircraft (with respect to DAs) in real-time and uses these values to propose possible assignments between anti-aircraft weapons and observed enemy aircraft. A team of researchers from the department of Logistics at the University of Stellenbosch (and various military collaborators) are pursuing the task of creating a body of knowledge regarding TEWA decision support within a South African context.

Project Background

This project has its roots in the South African Ground Based Air Defence System (GBADS) project, a concept originating in the mid 1990's. In January 2003, a contract was signed between the Armaments Corporation of South Africa (ARMSCOR) and Denel (accepting the responsibilities of prime contractor) for the development of a Phase 1 GBADS. The development of the Air Defence Control (ADC) software (which included a TEWA system) and the integration thereof with commercial off-the-shelf hardware was subcontracted to Reutech Radar Systems (RRS), based in Stellenbosch.

At that time, very little knowledge regarding TEWA decision support was available in South Africa and since the inner workings of TEWA systems are typically kept secret, detailed information was not easy to come by. A TEWA decision support system was purchased and received as a "black box" (*i.e.* no information regarding the algorithms that govern the system were provided). The requirement to initiate a local centre of excellence regarding TEWA decision support was identified and RRS approached Mr Jaco Roux, then a prospective masters student at Stellenbosch University with a view to offer him a bursary to enrol for a masters degree with a thesis topic related to TEWA decision support design.

Prof Jan van Vuuren (Department of Logistics, Stellenbosch University) and Mr Pieter-Jan Wolfaart (RRS) accepted co-supervision responsibilities for Mr Jaco Roux. A thesis topic and proposed thoughts regarding a locally based TEWA project were presented on 18 June 2003 to various role-players in technology at RRS.

Mr Jaco Roux completed his MscEng degree entitled "*Real-time Threat Evaluation of Fixed Wing Aircraft in a Ground Based Air Defence Environment*" in December 2005 and the work contained in his thesis was presented at the 2004 ORSSA Conference in Bellville, at the Institute for Maritime Technology in Simonstown in October 2004 and at the First LEDGER Conference in Pretoria in November 2005.

Due to an increase in interest on a national level, ARMSCOR agreed to fund an expansion of the project in the form of a PhD study by Jaco Roux as well as seven masters and two honours projects and several interest development projects for previously disadvantaged students, all running concurrently over the period 2005-2008. The work subsequently conducted as part of this project has been presented at several conferences, including the 2006 ORSSA conference in Pietermaritzburg, the Second LEDGER conference in Simonstown in 2006, the 2007 ORSSA conference in Cape Town, as well as during a data acquisition visit to the *Test Flight and Development Center* (TFDC) near Bredasdorp.

Current Project Status

On a higher level, Mr Jaco Roux is busy with a part-time doctoral project in engineering sciences (operations research) entitled *"The Design of a Real-time Threat Evaluation and Weapon Assignment (TEWA) system"* involving the design, integration and implementation of threat evaluation and weapon assignment algorithms for a GBADS into a fully fledged operational TEWA system. This is a direct consequence of Mr Roux's previous work on master's level.

Mr Jaco Roux also co-supervises seven masters projects within the TEWA program alongside Prof Jan van Vuuren. A paper by JN Roux and JH van Vuuren entitled "*Threat evaluation and weapon assignment – "A review of the state of the art*" has been accepted for publication in ORiON and will appear in the December issue. Further articles are also in the pipeline.

TE Research

Threat evaluation (TE) consists of all the investigative and operational activities designed to identify, assess, and manage anything which might pose a threat to DAs. For the purposes of this TEWA project, identification and classification of aerial threats are done by a process outside of the TEWA system and only hostile or unknown tracks are sent to the system. This TE process begins during the Intelligence Preparation of the Battlefield (IFB), a pre-deployment process, and continues during real-time evaluation of the battlefield and interpretation of available intelligence data into a real-time threat assessment of unknown or hostile entities.

Real-time TE, however, is far more challenging than IPB,

mainly due to time constraints associated with the highly dynamic nature of the modern battlefield and the short time spans and intervals of strikes executed by modern weapon platforms. Although traditionally ill-defined due its cognitive nature, recent advances in real-time TE provide for the estimation of threat using mathematical models depending on two main threat attributes, namely capability and intent.

Capability refers to the ability of a target to inflict damage to one or more DAs. Attributes considered when evaluating capability of a hostile aircraft or group of aircraft include amongst others; size of a flight formation, proximity to the DAs, aircraft types and likely weapon and delivery types.

Intent is the measure of the willingness or determination of a hostile aircraft to attack a DA. This is less trivial to estimate than capability, since it exists in the cognitive domain and cannot be measured directly by known factors in real-time. However, if behavioural aspects of the aircraft are taken into consideration, such as an increase in speed or a steep pitch, and correlated with known weapon delivery techniques, the intent of the hostile aircraft may be forecast depending on the strength of the correlation.

To this end, TE research is being conducted by three masters students within the TEWA research group, Jacques du Toit, Willa Lotz and Andries Heyns.

Different tiers or types of TE models are shown in Figure 1. The upper tier represents flagging models, the simplest form of TE model. These notify the Fire Control Operator of any sudden changes in aircraft behaviour.

The second tier, deterministic models, consist of simplistic models that take into account attributes such as aircraft time to DAs and aircraft bearing towards DAs as shown in Figure 2, in order to assign a threat value to each aircraft. These models require no prior knowledge of aircraft type, weapon capability or attack technique and form the basis for most operational TEWA systems in the world today.

The final tier, probability-based models, are the most complicated form of TE model incorporated in the system and are the focus of most of the TE research being conducted within the TE team.

Willa Lotz is currently pursuing a Masters of Engineering Sciences degree in Applied Mathematics; his thesis is entitled *Aircraft Membership Estimation in a Ground Based Air Defence Environment*. His research involves the pre-deployment classification and real-time identification of formative element combinations (aircraft, weapon type and aircraft attack technique) and aircraft attack technique stages. The algorithms derived in this project are used as subroutines in the probabilistic threat evaluation system (third tier in Figure 1). The objectives of the project are (i) to establish a generic approach for the construction of probability density functions based on historical values of aircraft attributes, (ii) to establish a generic statistical approach for the analysis of formative element combinations and aircraft attack techniques, and (iii) to determine a set of critical aircraft attributes which allow for the sufficient estimation of the probability that a formative element combination is embodied in an observed aircraft, as well as the probability that an observed aircraft finds itself in a particular stage of an aircraft attack technique.

Andries Heyns is enrolled for a masters project in applied mathematics (operations research) entitled Measuring the Threat Value of Fixed Wing Aircraft in a Ground Based Air Defense Environment involving the development of detailed TE algorithms for use as sub-procedures in the deterministic

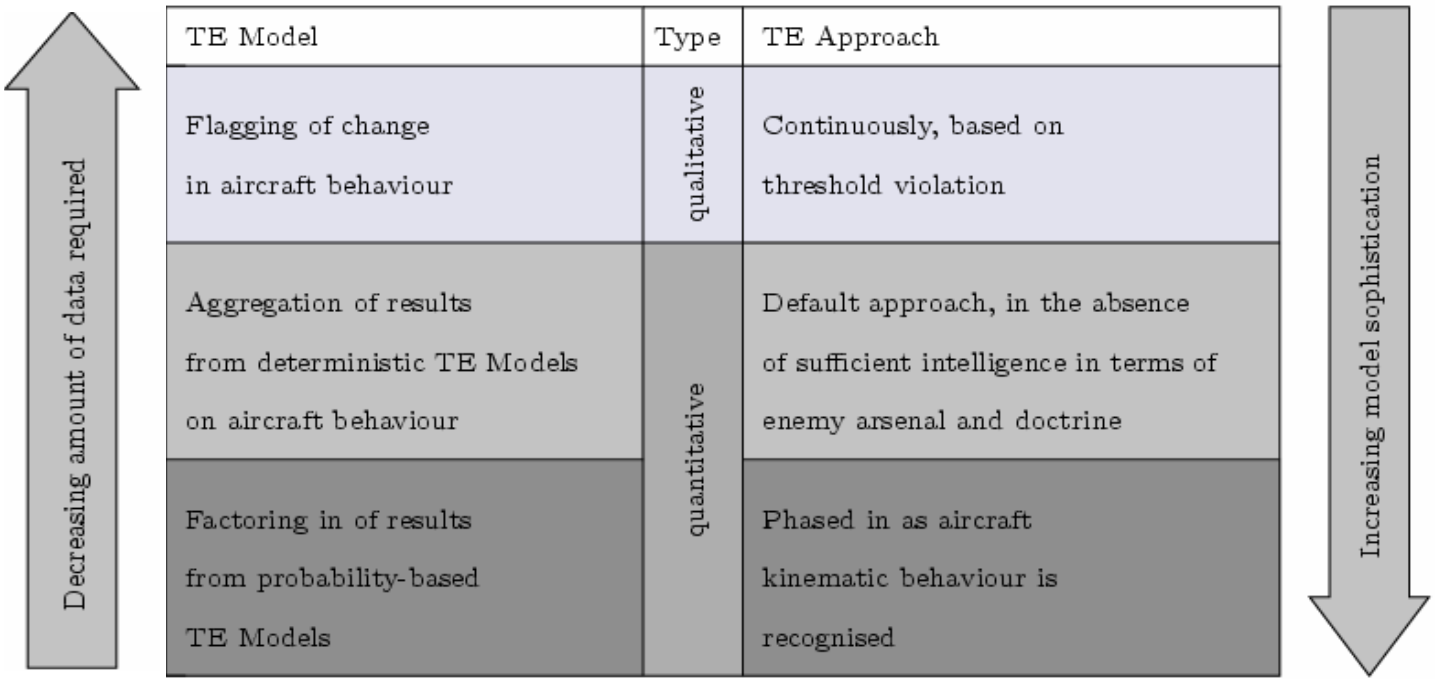

Figure 1: Different tiers of TE Models.

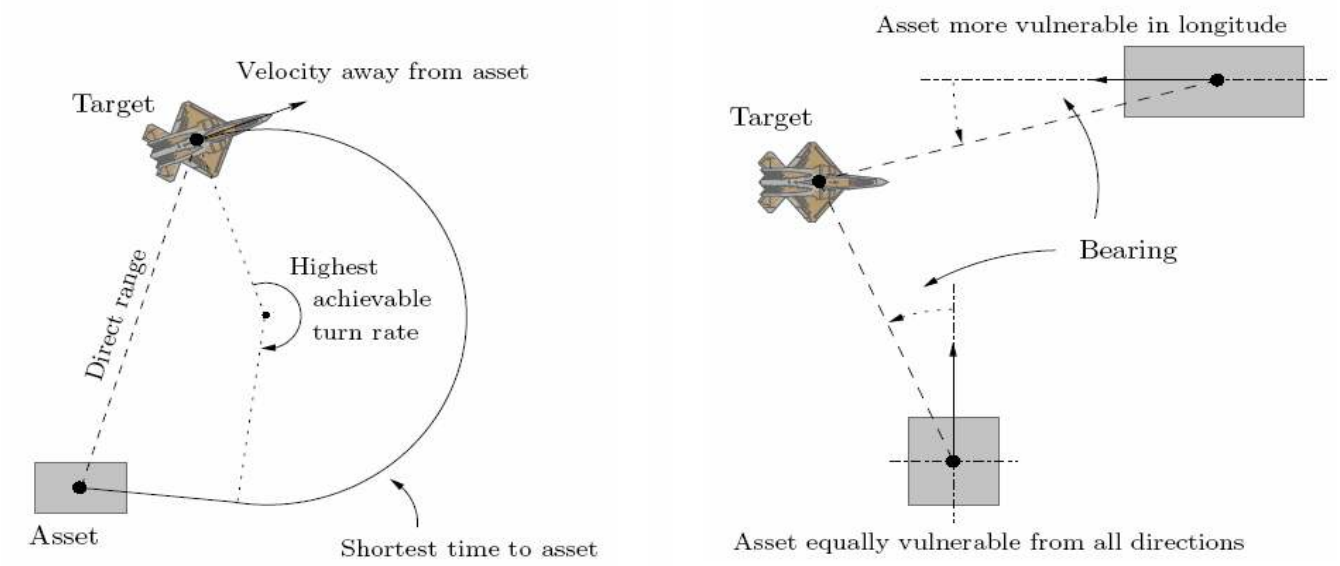

Figure 2: Deterministic TE models.

TE system (second tier in Figure 1). The objectives of the project are (i) to model the tactical environment including terrain and weapon delivery profiles so as to perform TE techniques thereupon, (ii) to develop detailed TE models for use as sub-components in determining aircraft attack intent, (iii) to develop procedures that consider various factors in the TE domain so as to determine a final aircraft threat ranking to aid the expert in assigning weapons to aircraft, and (iv) to investigate various existing algorithms and concepts to determine possible alternative applications and execution techniques for optimal application in the TE.

Jacques du Toit is studying towards a masters of science in applied mathematics (operations research) entitled *The probability of Attack of a Fixed Wing Aircraft in a Ground Based Air Defence Environment*, a subcomponent of the probabilistic threat evaluation system (third tier in Figure 1). This research aims to estimate in real-time, the probability that an enemy aircraft may attack a specific asset within a given time window, whilst flying a particular weapon delivery profile. Fundamental to this calculation is the consideration of pertinent kinematic quantities (derived from radar sensors) in order to establish future flight envelopes for each known profile. The prediction of feasible flight paths necessitates the development of a mathematical description of aircraft motion which additionally lends itself to producing profiles for use in simulation of the broader TEWA system.

TEWA WEBSITE

A website presenting more detailed information about the TEWA project is currently under construction at:

http://www.tewa.co.za

The website should be fully functional by December this year.

WA Research

WA decisions are considered more easily quantifiable than TE, and thus the challenge lies more in the solution methodologies of the problem, rather than the formulation, as is the case with TE. Consider for example the following NP-complete formulation of a weapon target assignment problem:

$$\text{minimise} \quad \sum_{j=1}^{n} V_j \prod_{i=1}^{m} q_{ij}^{x_{ij}},$$

$$\text{subject to} \quad \sum_{j=1}^{n} x_{ij} = 1, \qquad i = 1, \ldots, m$$

$$\text{and} \quad x_{ij} \in \{0,1\}, \qquad i = 1, \ldots, m \quad j = 1, \ldots, n$$

where

p_{ij} = probability that target j will be killed of attacked by weapon i,

$q_{ij} = 1 - p_{ij}$ = survival probability of target j if attacked by weapon i,

V_j = priority/importance of eliminating target j,

$x_{ij} = 1$ if and only if weapon i is assigned to engage target j.

This formulation does not include temporal optimisation, a further complication that needs to be addressed by WA algorithms. Research into WA algorithms is being undertaken by three masters students, Grant van Diemann, Francois du Toit and Cobus Potgieter.

Cobus Potgieter is completing a masters project in engineering sciences (applied mathematics) entitled *Real-time Weapon Assignment in a Ground Based Air Defence Environment* involving the development of real-time WA system which provides the operator with engagement proposals between available weapon and sensors systems, and observed threatening aircraft. The objectives of the project are (i) to introduce a transparent, elementary framework in which

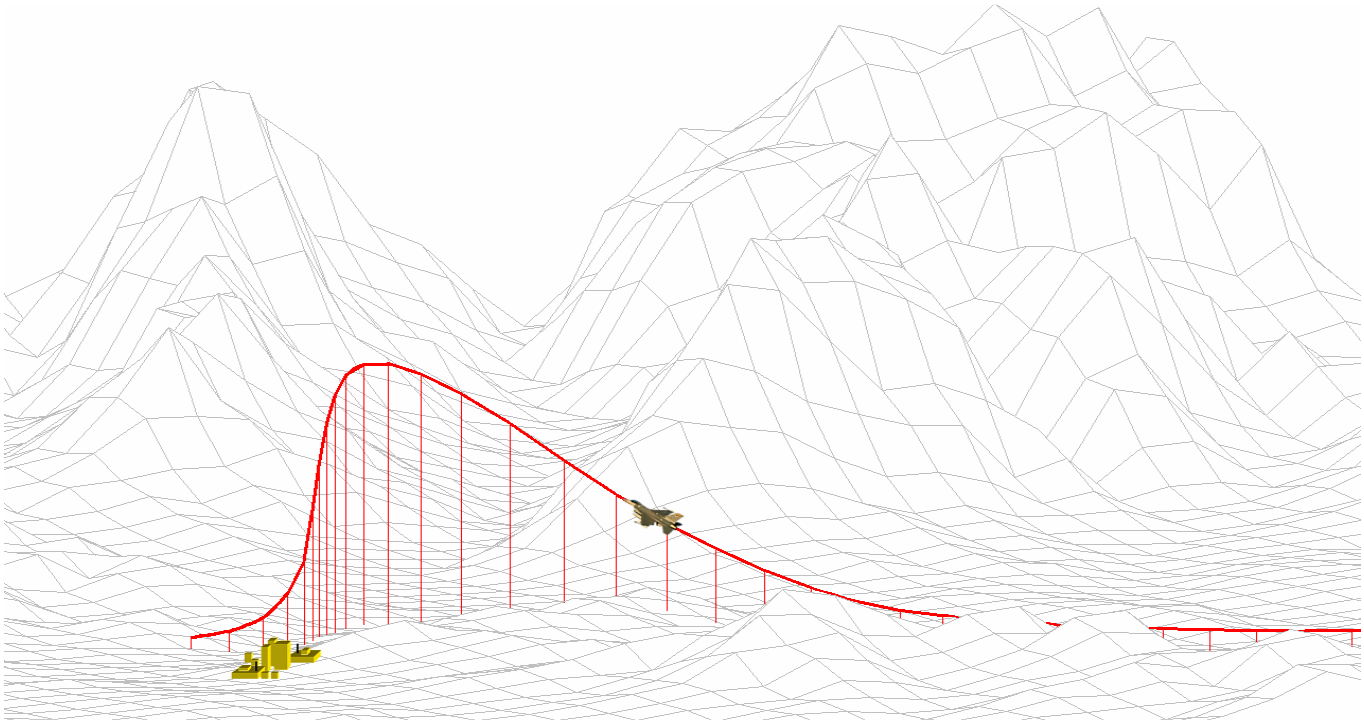

Figure 3: A typical weapon delivery technique.

the WA problem may be investigated, (ii) to establish preliminary decisions required for the development of a mathematical model for WA, (iii) to develop and implement a mathematical sub-model used to analyse the capabilities of a weapon with respect to enemy aircraft in real-time (iv) to develop and implement a simple rule based model for WA assignment in the military domain. The main focus of this work is to propose a high level architecture for a WA system and to design real time WA heuristics for solving the WA problem.

Francois du Toit is busy with a masters project in operational analysis entitled *The dynamic Weapon Target Assignment Problem in a Ground Based Air Defence Environment* involving the derivation and formulation of a mathematical model capable of providing temporal decision support to a commander or operator with respect to the assignment of weapons to engage observed enemy aircraft in a ground based air defence environment over a finite number of future time intervals. The model takes as input quantities parameters such as single shot hit probabilities of the various weapons and the priorities of eliminating enemy aircraft based on their threatening kinematic behaviours with respect to the assets, and suggests and updates a weapon-aircraft engagement list at each time step, based on an appraisal of predictions of the tactical environment over a moving future time window.

Grant van Diemann is conducting his masters project in operational analysis entitled *A comparison of exact and heuristic solution methodologies for the classical assignment problem and its variations* involving, as the title suggests, an in depth analysis, implementation and comparison of a number of solution methodologies for the classical assignment problem and variations thereof, such as the assignment problem with assignee qualifications, the *k*-cardinality assignment problem, the bottleneck assignment problem, the balanced assignment problem, the lexicographic assignment problem, the semi-assignment problem categorized assignment problem, the multi-criteria assignment problem and the quadratic assignment problem. The exact solution techniques considered include the successive shortest path algorithm for maximum flows in a graph, the maximum weight graph matching algorithm, the Hungarian method and a branch and bound technique, whilst the heuristic methodologies include a tabu search approach and a genetic algorithmic implementation. The techniques are compared both in terms of their execution times and solution qualities.

Testing and Evaluation

Testing and evaluation of a TEWA system is imperative in order to demonstrate workability of the TEWA system as a whole as well as sub-components thereof. Basie Kok is currently under way with an MSc entitled "*Evaluation of a fully fledged TEWA in a Ground Based Air Defence environment*." His intention is to use discrete event simulation to evaluate various TEWA sub-components for fixed scenarios (asset deployments). This process involves the generation of attack profiles using the techniques developed by Jacques du Toit and investigating the effectiveness of ground based defence against these airborne threats using TEWA models developed to date. Part of the work will involve the development of an interface to communicate between the US TEWA system and a virtual GBADS demonstrator developed by the CSIR which will allow for integrated testing and evaluation of some of the TEWA models discussed here in a virtual GBADS environment as well as testing of completely separate TEWA systems that can also communicate through the interface.

Montecarlo simulation will then be used to evaluate the performance of the system by measures such as asset

preservation and resource utilisation efficiency.

Interest Development Projects

A growing number of *previously disadvantaged individua*l (PDI) students have been working on the project in the form of interest development projects, including the development of a TEWA Knowledge Base, a TEWA Website, and vacation work where students implemented several mathematical models to complement some of the masters projects. The ideal of these interest development projects is to spark interest and broaden PDI students' perspectives with regards to the military and air defence domains. These PDI students are further encouraged to enrol in post-graduate studies within the TEWA project team.

Future Activities

Although the current horizon for the project is the end of 2008 it is hoped that funding renewal will allow for new students to become involved so as to extend the project further.

It is conceived that the knowledge base (forming part of this first TEWA project) may be useful for investigations into higher levels of TEWA (*i.e.* TEWA on a joint AD level) as well as into the challenging domains of operations other than war, such as reaction force assignment for the South African Police and Intelligence services. The next phase of students are expected to pursue TEWA related work in some of these challenging domains.

Many of the students mentioned in this article will hopefully be presenting at the 2007 Ledger conference in November and possibly at the international IFORS 2008 conference in Sandton, Johannesburg.

Collaborators

Close cooperation with several partners in industry has been established in order to validate the work conducted by the TEWA group in Stellenbosch through expert opinion as well as to gain insight into the practical implications of an operational TEWA. Some of these partners include:

Reutech Radar Systems (RRS), Stellenbosch; RRS has supported the project since the very beginning providing expertise from a sensory aspect (radar inputs) and finances where needed.

The Council for Scientific and Industrial Research (CSIR), Pretoria; Close cooperation with the Defence, Peace, Safety and Security (DPSS) branch of the CSIR has been established, more specifically regarding the use of their Virtual GBADS Demonstrator (VGD) for simulation and visualisation of TEWA components for evaluation and comparison purposes.

The User Doctrine Development Committee (UDDC), Kimberley: The UDDC is responsible for development of doctrine and procedures for GBADS operators. Their expert opinion on the workings of a defensive battlefield scenario will give valuable insight as to how to best structure and present information during decision support. The UDDC also acts as a vehicle to plough the TEWA knowledge base back into the army at a recruits level, through the development of doctrine and protocols to be followed by GBADS operators.

Test Flight and Development Center (TFDC), Bredasdorp; A work session took place at TFDC near Bredasdorp in order to attempt to acquire data. Valuable information from an offensive point of view (aircraft) was gathered from fixed wing fighter pilots, including how attacks usually take place and the type of formative element combinations used against various ground targets. This gave the TEWA group at Stellenbosch a valuable insight into how to go about developing certain aspects of TEWA.

Institute for Maritime Technology (IMT), Simonstown; TEWA interest from IMT has grown gradually from a navy point of view after the acquisition of the German Corvette Frigates for the South African Navy. A good relationship between a small number of researchers of IMT and the US has already been established, based on previous visits. A visit by the whole TEWA research group to IMT has been scheduled for 13 November this year. It is hoped that further fruitful relationships between researchers based at IMT, Ergotek and the TEWA research group will be established.

Conclusion

The TEWA project has picked up significant momentum during 2007 and although many obstacles still lie ahead, the team has a very positive energy and a sense of pride in what they are doing.

As a leader in Africa, South Africa is expected to be able to make a stand in Africa and in so doing be the primary peacekeeping instrument available to the AU. We believe that the South African GBADS program, and in particular the TEWA project, is in line with this ideal and as such we will continue to work hard to hopefully produce a truly exceptional product.

Acknowledgements

The TEWA team are especially indebted to Mr Bob Visser and Mr Pieter-Jan Wolfaardt (RRS), Dr Jan Roodt and Mr Cobus Nel (CSIR--DPSS), and Mr René Oosthuizen (Monze Consultants) for many fruitful discussions and for making the facilities (libraries and software) at their institutions available to for this project. The authors are also indebted to Srg WO1 Piet Gouws, Lt Col Lappies Labuschagne and Maj Lance Wellington, all from the SANDF, for valuable end-user input. We further thank Mr Peet Fourie and Mr Sven Holfelder (RRS), as well as Mr Schalk Verwey (Denel), for their willingness to share considerable expertise in the military industry with us. Ms Anita Louis, Mr Herman le Roux, Mr Shahen Naidoo and Mr Bernardt Duvenhage (all from CSIR--DPSS) as well as Dr Martie Muller, Mr Danie Bence and Mr Leon Downes (from IMT) are thanked for valuable inputs with respect to real-time TEWA simulation and testing. Mr Gerhardt Strutters and Mr Daniel Seegmuller (TFDC), Mr Johan Badenhorst (Epsilon) and Mr Jan Durand (ARMSCOR) are thanked for their efforts to make real test data available to the authors. Finally, the TEWA team are grateful to Mr James Verster and Mr Johan Bras (RRS), Mr Johan Mostert (ARMSCOR) and Col Tammy Mdekazi (SANDF) for arranging funding for this project and for facilitating contact with operators and experts of the SANDF.

Data quality the key to accurate information

by Jotham Mapundi, Director Public Sector at SAS Institute

A major challenge for public sector bodies is not just the quality of data, but the mere presence of it. That said the data that is at the hands of the government organisations in South Africa is, in many instances, incomplete and inconsistent, and often out of date. It is difficult to perform true analytics on data where, for example, 5% of the people in the database are deceased, and another large percentage has moved.

While the nirvana for public sector departments the world over is to have a single view of its citizens, the reality is a far cry from that fact, as access to data which encompasses all of the above-mentioned aspects is possibly more challenging to them than their corporate counterparts.

There are four major challenges facing the collection and integrity of data in the public sector, which cause problems when trying to pull intelligence out of the available information, or when trying to run BI solutions on this data. These include accuracy, inconsistency, timeliness and availability issues.

ACCURACY ISSUES

Problems of accuracy occur when stated facts do not match reality. This can be because data is often times out of date, corrupt or has been incorrectly captured. Traditionally government agencies have collected data via forms, which can often mean that data captured is in fact incomplete or inaccurate as the right information is not revealed.

Sometimes forms are also used across purposes to save money, making some of the information redundant or even irrelevant, and when irrelevant gaps in forms are left blank, it opens the way for incompleteness. Blank fields when dealing with data analysis are bad, as they can often times represent nil or be taken to mean zero, if analytical tools are not intelligent enough to see past the values.

INCONSISTENCY ISSUES

Data which is inconsistent or inaccurate can cause real problems when trying to draw facts from it. For example, Gauteng abbreviated as GP, GTG or Gaut, may cause problems in a system that has not been coded to make room for exceptions. The knock on effect could leave several departments with the wrong information as opposed to merely a single instance.

When working with business systems, with data inconsistencies one may have problems when sending out bills and other information to customers. In the case of a municipality an incorrect form may create a duplicate in the system and in error send out two bills to the same person.

TIMELINESS ISSUES

Data that is out of date can unnecessarily load your system and clog your reports, while at the same time hamper the accuracy of the reports you are trying to build. Government departments have to sometimes rely on data that is as old as birth data, as no other contact has been made with the citizen since. Sometimes rather than not crunching the information, old data or estimates are used.

DATA AVAILABILITY

Sometimes the way in which data has been collected is just wrong, or incompatible with your existing workflow environment. When data is not immediately available it can leave flaws in your intelligence, or gaps in the decision making process. Sometimes the data has just never been collected and therefore is just not available.

GETTING IT RIGHT

There are so many good business cases for BI in the public sector. A single view of citizens, being able to measure socio-economic factors and their impact on people development, ensuring funding to the right areas, consolidation of citizen information and access to this - we really do not need to justify the need for it.

The reality however is that data quality issues scare the public sector 'enterprises' off in many instances. But one needs to start somewhere and there are a number of tools available today that do not need you to reinvent the wheel, they simply need for you to have the business case to ensure data integrity. To quote the age old IT expression ... Garbage In, Garbage Out.

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ORSSA 2007 – A Developmental Perspective

by Darian Raad (darianr@sun.ac.za)

My second ORSSA conference was, as is fast becoming the norm, a stimulating and enriching experience. It is a pleasure to engage with this group of intelligent, compassionate people, on the cutting edge of an exciting field which is severely under-utilized in our country and continent. This year's conference was a joint venture with ORPA, drawing representatives from five continents and several African countries. In this article I have chosen to further explore the theme of "OR practice in Africa/OR for development."

Africa is a grand mess. To quote one of the delegates from Nigeria: "Nothing works in Nigeria." If we exclude the tarnished *Jewel of the South*, and focus only on Sub-Saharan Africa (SSA excluding South Africa = SSA/SA), we can unearth some horrible statistics. While 11% of the world's population call SSA/SA home, it generates less than 0.64% of the world's income. The per capita GDP is in the region of $400 (IMF 2006), compared to America's $39430 (World Bank, 2007), and this figure is grossly distorted due to extreme income inequality – the lowest 50 percent receives less than four percent of the income, and the majority of them live below the poverty line. The UN human development index indicates that the world's worst 18 countries are all SSA/SA members (Economist, 2007). Another grim reality is that life expectancy in the region is only 44.8 years for males and 46.3 years for females – primarily due to the Aids epidemic. There are severe crises of health, education, security, and infrastructure. There is a distinct absence of proper economic, judicial and financial institutions necessary for a workable capitalist economy. There is a grave governance crisis characterized by corruption, maladministration, and lack of political capacity and accountability. It is estimated that for every dollar borrowed by SSA/SA countries, 80 cents leaves in the same year as capital flight. It is further estimated that corruption costs Africa $148 billion annually (African Union, 2006). The ex-president of Nigeria, Sani Abacha, was asked to please return the $4.3 billion which had migrated to a multitude of Swiss bank accounts. The latest suspect is the ex-president of Kenya, said to be involved in a $5 billion corruption caper. Since 1980, the per capita income has declined by almost 1% per annum, although there has been a recent growth spurt caused primarily by high oil prices and humanitarian foreign investment. Unfortunately, growth of 3% on $400 is pretty feeble.

Why is Africa in this state? I believe that the cause lies primarily in the long history of systematic exploitation and malign intervention of external (mainly Western) powers. The Arab and Western slave trade of over a thousand years caused catastrophic, long-lasting social disruptions and undermined the stability and humanity of African culture. The colonization of Africa which ensued, was primarily a scramble for African resources, sweeping its people aside to satisfy the ravenous greed of the outsiders. One professor at Stellenbosch is fond of saying that the developed world is built on the pillaged resources of the third world. The premature decolonization of Africa (1957-1973), caused amongst other things by the Cold War, was implemented too quickly and for the most part for the wrong reasons, resulting in a flawed transition of power devoid of enabling structures and checks and balances, which still persist in governments today. Finally, Africa was subjected to "structural adjustment programs", implemented by the IMF as one of their conditions for debt absolution, the focus of which was intended to enable global trade and give debt-stricken countries a chance to start over. However, little emphasis was placed on nurturing human capital and western power interests were unfortunately for the most part the real focus of the programs.

What is needed to reverse the situation? If the Rich North decided to make Africa a high priority, it could easily end extreme poverty. No quick fixes though – this would take a huge investment (by African standards) of foreign expertise and capital over decades. Interventions would be necessary at many levels simultaneously to attend to the multitude of crises. Of course, these interventions could not be forced upon countries – it would have to entail a "partnership between Africa and the developed world." (Blair/Brown *Commission for Africa*, presented at Gleneagles in 2005). Despite the recent rise in African activism and some honourable plans for enhanced development aid, the rich world has thus far failed dismally to live up to its commitments. The poorest countries in SSA/SA receive a small percentage of their miniscule GDP as official development aid – much of which gets 'misplaced'.

It is difficult not to be pessimistic in light of the extreme challenges facing SSA, but there are glimmers of hope. Growth in SSA has started to turn positive with increasingly diverse growth patterns – 20% of Africa showing virtual stagnation and 29% of oil-exporting countries growing in the region of 6.5% (although they are notorious for corruption). Also, productivity in Africa's best performers (roughly 25% of Africa) is the equal of Asian competitors, and primary education enrolment is at an all-time high of more than 90%, although secondary and tertiary education is still the worst in the world. However, these facts by themselves are not sufficient for optimism. My optimism derives from the growing international interest in Africa, the expanding number of high-profile African activists, and the international strategies – though chiefly theoretical at this stage – to eradicate extreme poverty. African leaders are more open than ever to the idea of foreign partnerships and the ratio of investment to GDP is at its highest ever. With this in mind, the question arises – what can OR do to help?

Operations Research should not be considered a heal-all balm. It has the ability to achieve enormous gains for a variety of objectives and enable informed decision-making. It should rather be seen as a critical gear in the structure of effective societies.

In particular, in a continent where so many things are dysfunctional and funds are extremely limited, it has the ability to effect massive improvements in service delivery, and investment/infrastructure planning in line with multiple objectives, constraints and value systems.

A major concern of "OR for development" should be the number of lives which are improved through its use. I believe this makes a strong case for promoting its use in government, whose activities affect many more people than any one industry. If OR is to have any success at all, it needs to infiltrate the social consciousness, particularly of those in power. Ineffective governments are the major limitation to the successful application of OR.

OR education is a vital cog of the gear. If OR can be 'normalized' across the education system and treated as a standard part of decision-making, it can penetrate new markets and governmental structures. The ORSSA conference included a workshop on "OR in Education" which was highly successful. Jim Cochran discussed his quest to "Ennobilize through Mobilization." This he achieves primarily by developing first-rate OR practitioners in an integrated process of active learning, case-based teaching, and project-based learning. Through active learning, students are engaged (excited) using activities designed to stimulate higher-order thinking, long-term retention, and develop problem formulation and analysis skills, using a variety of creative games, puzzles and experiments. Case-based teaching exposes students to interesting, relevant problems, developing their comprehension. Finally, challenging projects enhance their appreciation of real-world problems and improves their proficiency at problem solving and independent thought. Jim is eager to demonstrate the value of OR to other groups, and discussed his involvement with the public and NGO sector, including Habitat for Humanity and the Clinton Foundation – a potent force in the African development effort.

OR work-shops for government officials were discussed, with emphasis on demonstrating practical results, particularly in the public domain. I would like to cite Chile as an example of the successful reform of a third-world country which includes a strong OR component in government policy-making. With progressive growth strategies and institutional reform they have managed, since 1990, to reduce poverty from 38.6 to 18.8 percent, and extreme poverty from 12.9 to 4.7 percent.

ORSSA was fortunate enough to have an address from the Statistician General, Pali Lehohla, who discussed the challenge of optimization within the complex environment of South Africa, where objectives are never clear and always multi-dimensional. He is convinced that SA is fertile ground for OR, and challenged OR practitioners to exercise their role in bureaucracy. Certain researchers have found it extremely difficult to penetrate these very same bureaucracies, where lack of understanding and resistance to technical expertise is rife. This warrants development on several fronts – management and technical training for government officials, and the improvement of marketing / presentation skills for operations researchers. OR needs a closed loop between the decision makers and the analysts, wherein the needs of all relevant parties are fully considered, and proposed solutions are made easily accessible. Here I am thinking of liberal doses of movies, pictures, colourful tables and graphs, and beautiful animated computer simulations. Advancing OR practice as a multi-way conversation may be achieved through the use of techniques such as scenario-based policy planning (Stewart, 2007). Another area where development is necessary is in government policy itself. OR/MS should be a part of standard operating procedure, whether through external consultation or internal expertise.

ORSSA was also privileged to have an address from Dr Eric Soubega, chair of Operations Research Practice in Africa (ORPA), a UK charity devoted to the application of OR to deliver sustainable development solutions in Africa. He made it clear that ORPA is an "action tank" focusing on 'practice' and servicing the end-user community. He stated that OR has huge potential to facilitate policy and decision making for the development of the continent. Organisations like ORPA are critical to raising awareness of OR and

(continued on page 14)

An address by the Statistician General, Pali Lehohla.

Much to discuss during the tea breaks!

International Association of Engineers

International MultiConference of Engineers and Computer Scientists 2008

IAENG International Conference on Operations Research (ICOR'08)

Hong Kong, 19-21 March, 2008

Proposals for special conference sessions and tutorials deadline: **30 August, 2007**
Draft Manuscript submission deadline: **12 December, 2007**
Camera-Ready Papers Due & Registration Deadline: **31 December 2007**
IMECS 2008: **19-21 March, 2008**

http://www.iaeng.org/IMECS2008/ICOR2008.html

Operational Research Society
4th Simulation Workshop (SW08)

Held in cooperation with:
The Association for Computing Machinery's Special Interest Group for Simulation (ACM SIGSIM)
The INFORMS Simulation Society
The Society for Modeling and Simulation International (SCS)

1-2 April 2008
The Abbey Hotel Golf and Country Club
Worcestershire, England

The biennial Operational Research Society Simulation Workshop brings together practitioners and academics working in the field of discrete-event simulation. It provides an opportunity to exchange ideas on the current and future state-of-the-art in simulation and modelling. At SW08 we will be celebrating the 50th anniversary of KD Tocher's major contributions to the field of simulation.

http://www.orsoc.org.uk/

demonstrating its efficiency in solving relevant developmental problems. Dr Soubega stressed the fact that one cannot consider the continent in isolation, but that external partners are required to supply aid, technology and education. ORPA has arranged some high-profile awareness events. He raised the possibility of MBA-style OR programmes, and emphasized that training be adapted to the African context.

The comment was made that "OR should not be for free." OR is a valuable and difficult discipline and it won't receive the respect it deserves if it is provided as charity. And yet, because it has the potential to achieve broad benefits far greater than the cost of the research, it may be used to uplift large segments of society.

One of the critical areas of Africa's development is the Agriculture sector. It is responsible for 35% of regional GDP, absorbs 70% of the labour force and yields 40% of its exports. And yet it is seriously underdeveloped, short of technology and modern farming practices, and limited by the availability of supporting infrastructure. This is another huge opportunity for development, especially in light of the global drive to prevent catastrophic climate change and curb emissions: "Making a mess – why not grow an African farm?"

The greatest products fail with bad marketing. The natural fear of complicated things and proliferation of OR euphemisms calls to mind a need for factor analysis in the design of the OR image. I think that the community should reconsider how they can successfully portray the subject and present a united front – "OR/MS" is not particularly user-friendly but "Science of Better" makes me feel all warm and fuzzy. The websites of most OR societies may be sufficient for informative purposes, but they should be modern, dynamic and gorgeous. Informs has done rather better than the rest with www.orchampions.org, and www.scienceofbetter.org., and ORSSA is on track with the latest conference website. Perhaps a randomized Google Adwords campaign could be used to identify successful names and slogans to be used in a marketing drive. Infiltration into popular media is another route which may be successful. Here I am thinking of partnerships with governments, NGOs and OR software companies to finance television shows in the vein of "How to Solve It" or "Science and Society".

People should not be afraid of OR. It is an extraordinary tool for improvement. We need to tear off the label of "Terminal Disease" and show everyone how cool OR is. The IFORS 2008 conference is a fantastic opportunity for showcasing OR to South Africa.

Finally, a personal highlight of the ORSSA 2007 conference was the women. As a recent convert to radical feminism, it was a pleasure to see such strong representation of the gentler sex in this traditionally male-dominated field. I would like to thank one woman in particular – my auntie Rhonda, who kept my friends in good supply of chocolates and chips – may her larder never run dry.

SPECIAL ISSUE OF *ORiON* DEDICATED TO GERHARD GELDENHUYS

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

Volume 23(1) of *ORiON*, the journal of the Operations Research Society of South Africa (ORSSA), was dedicated to professor emeritus Gerhard Geldenhuys, a pioneer of operations research in South Africa, on the occasion of his 70th birthday this year. It is the first time in its 23 years of existence that an issue of the journal has been dedicated to somebody.

Gerhard Geldenhuys spent the academic year 1961-62 on study leave at Harvard University in the United States. Upon his return to South Africa he spent the period November 1962 to March 1963 as researcher at the then National Research Institute for Mathematical Sciences (NRIMS) of the CSIR. During this time he produced a seminal report on possible applications of operations research in South Africa. This report turned out to be visionary in the sense that virtually all areas of application mentioned therein realized during later years. The report directly influenced operations researchers at the CSIR, and Gerhard was also the first university lecturer to incorporate operations research courses into a tertiary curriculum, at the University of Stellenbosch where he spent the whole of his working life. In this sense Gerhard was a pioneer of operations research in South Africa. When ORSSA was formed in 1969 Gerhard was present – and he remained a member until his retirement in 1998. Since 1999 he is one of only three honorary life members of ORSSA.

The editor of ORiON, Jan van Vuuren, presenting a copy of the special edition of the journal to Gerhard Geldenhuys.

It was decided to dedicate specifically Volume 23(1) of *ORiON* to Gerhard for his enormous contribution to operations research over many years, so that a signed copy of the special issue could officially be presented to him by the president of ORSSA at the 37th annual ORSSA conference, held in Cape Town in September during the year of his 70th birthday. However, an unofficial presentation of the journal was already made to him on Friday 15 June 2007 by the Editor of *ORiON*, Jan van Vuuren (see picture above), together with several authors who contributed papers published in the special issue (namely Alewyn Burger, Hennie de Kock, Isabelle Nieuwoudt, Wessel Pienaar, Theodor Stewart, Esbeth van Dyk and Stephan Visagie), so that he would not discover that the issue had been dedicated to him upon receipt of the journal in the post! Gerhard's birthday is, however, only on Monday 19 November 2007 … and we wish Gerhard a very happy and blessed birthday on this occasion – may there be many more!

2007 SAS Student Competition

by Margarete Bestier (MBester@PICSolutions.com)

This year there was a record number of entries for the SAS national student competition. A total of 4 honours students entered, whereas 3 master's students entered. The competition is held every year for project conducted the previous year. The honours projects this year were:

- Operation of the ESKOM hydropower plants at the Gariep and Vanderkloof dams by Tim Blake from the University of Cape Town with supervisor Theo Stewart.
- Safety stock placement in a multi-echelon supply chain by Marlize van Zyl from the University of Pretoria with supervisor Johan Joubert.
- Swarm Intelligence: A multiobjective production scheduling application by Jacomine Grobler from the University of Pretoria with supervisor Johan Joubert.
- Inventory modelling with a decreasing demand - A video rental case study by Basie Kok from the University of Stellenbosch with supervisor James Bekker.

In the honours section the winner and runner up were quite close together, but in the end the winning project was on a job shop scheduling problem and the use of particle swarm optimization and a study on the behaviour of birds and fish in a scheduling framework. Jacomine Grobler produced an excellent project in which the optimization technique showed promising results when compared with other traditional job shop scheduling solution strategies, being strongly dependent on the concepts of social intelligence and emergence.

It was the second year that the master's competition ran and already the number of entries we receive annually is increasing. The three Masters entries were:

- Robustness Analysis based on Weight Restrictions in Data Envelopment Analysis by Dieudonne Kabongo Kantu from the University of Cape Town with supervisor Theo Stewart.
- Population-based approach to sequential ordering problems by Carel Anthonissen from the University of Stellenbosch with supervisor James Bekker.
- A Decision Support System to Optimize the Available Resources at Kimberley Mines by Jeremias Cornelius du Toit from the University of Stellenbosch with supervisor Wim Gevers.

The overall winner of the masters section was Mr Anthonissen for his project on "*A population-based approach to sequential ordering problems*". The clarity of exposition of this thesis as well as its high academic quality, good lay-out and finishing together place it above the other projects. The results are very clearly reported and interpreted and the literature survey is relevant and insightful.

I would like to congratulate all the entries which were of an extremely high quality. I would also like to thank SAS for their loyal support throughout the past years as well as the referees Hennie Kruger and Petrus Potgieter for their excellent work.

OR and Global Business

September 3rd-5th 2008, University of Augsburg, Germany

Today's business has gone global in most manufacturing and service industries leading to an increased complexity of the underlying production, distribution and selling processes. Operations Research represents one of the most successful instruments for organizing such business processes, as many applications in the areas of, e.g., supply chain management or financial management show. However, still many new challenges are on the horizon, in particular when taking environmental effects into account. OR 2008 represents a platform for both, describing successful applications as well as discussing new developments.

http://www.wiwi.uni-augsburg.de/or2008/

ORSSA 2007 and OR Practice in Africa

by Theo Stewart (Theodor.Stewart@uct.ac.za)

The 2007 Annual Conference of ORSSA took place at the University of Cape Town during 10 – 13 September 2007. The first day was devoted to a workshop on OR Education convened by Jim Cochran of the Louisiana Tech University, Ruston, LA, USA, which continued in parallel with the main activities during day 2. The education workshop was partially supported by the Institute for Operations Research and the Management Sciences (INFORMS) and the Association of European OR Societies (EURO).

A central feature of the conference was the incorporation of the second conference on OR Practice in Africa (ORPA), the first having been held in Ouagadougou, Burkina Faso in 2005. It was this link to ORPA that was also the motivation for the INFORMS/EURO sponsorship of the education workshop. We were pleased to have participation of delegates from Burkina Faso, Nigeria, Kenya and Zimbabwe, while other visitors were directly attracted by the explicit ORPA theme.

This article is not intended, however, as a summary of the conference itself. Details of the programme can still be accessed from the ORSSA web page. Our intention here is to provide a brief summary of the animated closing discussion session on the potential for OR practice in Africa.

Eric Soubeiga, Group Chair of *Operational Research Practice for Africa* (a UK-registered charity), opened the discussion with the statement that the onus is on us (the OR community in Africa) to make OR what we want. This view had support from Alexis Tsoukias, representative of the EURO Africa project, who expressed the view that the "potential for OR in Africa was incredible", referring to statements in NEPAD documents concerning the role of OR. Delegates were encouraged to visit EURO-online (*www.euro-online.org*), to follow links to the African OR Network and to subscribe to this network.

The panel discussion was well attended.

Caston Sigauke reported on the launch of the Zimbabwean OR Society, and on their plans to exhibit at the International Trade Fair in Zimbabwe. Further discussion emphasized the need, however, to create sustainable OR societies by ensuring a critical mass through regional cooperation, as has occurred in East Africa (where a regional OR conference is to take place in March 2008) and in Francophone West Africa. The possibility of ORSSA arranging national conferences in neighbouring countries (as has already happened once in Swaziland) was also mentioned. In similar vein, Moses Okesola announced the establishment of the Institute for Operations Research of Nigeria (INFORN) which had organized a first "National Operations Research Day" in Lagos during the week before our conference.

As usual, there was concern expressed about how to raise awareness of OR, and especially in Africa. We need to make better use of the instruments available to us, especially articles for the popular press and use of the internet (perhaps building an African version of the *Science of Better* web sites). A starting point may be to collate a number of one-page case studies of OR success stories in Africa. Another suggestion was to develop professional training workshops (with prices set to demonstrate their importance!) aimed especially at government heads of departments and other high level executives, on the role of OR in Africa.

Mention was also made of the establishment of a specially designed MSc on OR in Development at UCT, which could be used as a basis for relevant OR training.

The above ideas are only a start. Many others will probably come to mind. But already there are a number of things we in ORSSA can start doing immediately. Let's get to it friends!

ORMS Today's

ORMS Today is the official magazine of INFORMS. Visit the ORMS site at http://ormstoday.pubs.informs.org or go to http://www.informs.org/ for more information on INFORMS.

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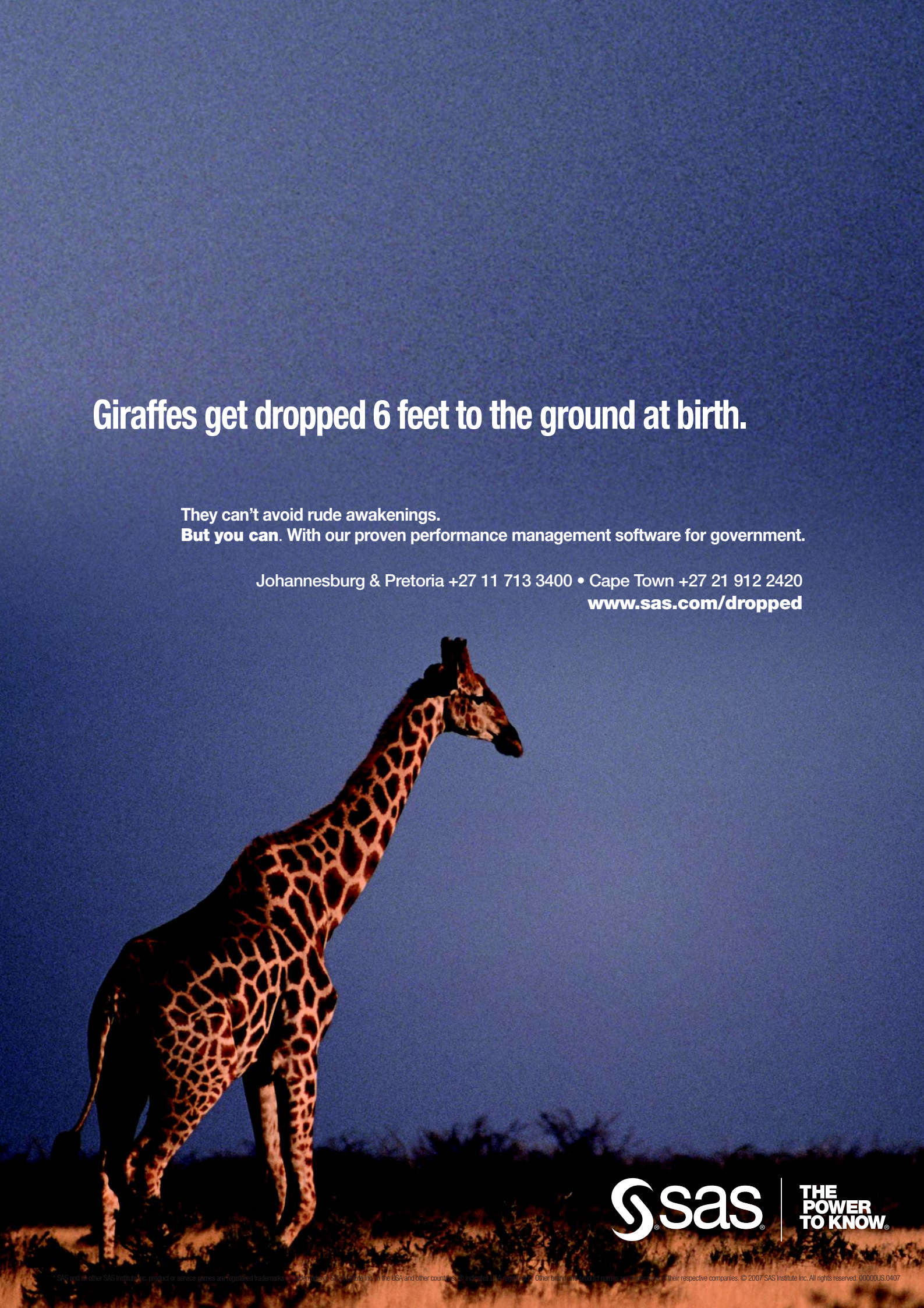
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