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ORSSA Newsletter December 2018

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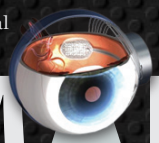

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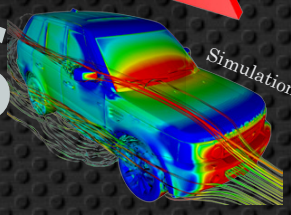

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From The Editor

By Brian van Vuuren
(brianjohnvanvuuren@gmail.com)

Brian van Vuuren

Dear ORSSA members,

Can you believe we are at the end of another year already? It's terribly cliché, but time really does fly! And, although you probably can't even begin to think where the year went, I'm sure if you take a break over this festive period to reflect on 2018 and all that it encompassed, you'll soon realise that, infact, you've achieved (and learnt) so much since the start of the year.

On a personal note, I completed my first working year in a non-academic environment within a field of expertise well outside my 'comfort zone'. Of course, this came with an abundance of lessons and epiphanies — realisations about my passions and interests which will help guide my career as I continue to grow and progress further.

At the same time my lovely wife, Courtney, completed her studies this year. She graduated with an LLB and will be hitting the professional working world in 2019. It's been so interesting to watch her soldier through her studies from a complete *outsider's* perspective. Our career paths differ so significantly that I could almost never be of assistance — not with knowledge regarding subject matter, nor with an explanation of how to apply a concept. Instead, I could only support with being an expert tea-maker and cheerleader.

Watching her complete her studies, however, reminded me once again of two important beliefs that I've held for a long time and which I'd like to share with you here.

Number one: education is a gift! How priviledged we all are to be able to invest time and effort into understanding the world around us. Whether the letter of the law, the programming of computers or the development of algorithms to optimise real-world processes — we should never forget how fortunate we are that we've had/have the opportunity to learn more and more about these intracate, complicated, astounding schools of thought that compose the world around us. I remember when once applying for a bursary, the application asked for an answer to the following question: "How would you invest R1million in order to double it in 3 years?"

Of course, ideas of stock markets, forex trading and offshore exposure ran through my head. Then, when chatting to a good (and much wiser) friend at a later stage, he shared his ideas, which I found inspiring. "It's simple," he said, "you invest in someone's education. The true value of an undergraduate degree far exceeds R2million rand!" And he was right — whether in rands and cents' worth of potential, personal achievement and satisfaction, or simply in life experience and enrichment; education is a gift which we should all treasure.

The second point which Courtney's studies reminded me of is that nothing that comes easy is ever worth having. I've never seen volumes of literature like those which law students need to read, understand and apply. In the same vein, I remember back to first year where I was convinced I'd never pass Engineering Maths 145. But hard work pays off (and we're usually a lot tougher, more intelligent and have more 'grit' then we think) and, by hook or by crook, through love and through labour, by an inch or a mile — we find a way to make it. It's a beautiful attribute of the human spirit and one we sometimes forget we even have. There's nothing like a big exam or project to remind you just how mentally and physically tough you really are!

I trust you will all have a blessed and festive Christmas period. Thank you to each and every person who contributed to the 2018 newsletters. Your time and effort is hugely appreciated by me and the society. I look forward to what a special 2019 will bring! Be safe this holiday, and please remember to allow yourself some well-earned time to relax.

See you in the new year!
Brian

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SOCIAL MEDIA

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From The President's Desk

By Danie Lötter
(danielotter@sun.ac.za)

ORSSA President

Danie Lötter

Greetings to all ORSSA members. As I am writing the last article from the President's desk, we are well into the second half of December and the end of the year is approaching fast. I believe that many members had a very busy year and that they are now starting to wind down into holiday mode for a well-deserved rest. This is also the final edition of the Newsletter for 2018 and is packed with interesting reading material for the holiday.

The year 2018 was once again a busy and successful year for ORSSA. Four of our Society's five chapters were very active throughout the year with providing members with networking opportunities in the form of meetups, colloquiums and workshops. I am happy to announce that we have found a new chair for the Kwazulu Natal chapter and I am looking forward to see how we can resurrect the chapter after it being dormant for quite a number of years. Furthermore, the Society had a very successful meeting in Pretoria in the form of its annual conference and the variety of papers presented at the conference is proof of the wellbeing of OR in South Africa. I would therefore like to heartily thank each member of the Society at large and extend a special word of thank you to the national Executive Committee in particular who have helped to make 2018 a successful year for ORSSA. The members of the Society are the lifeblood of our Society, and the commitment to ORSSA amidst severe pressures of work schedules and personal life responsibilities over the last year from a large number of ORSSA members have been both heartening and truly inspiring. Thank you all for helping to make ORSSA a vibrant and active professional home for Operations Research in South Africa.

Finally, allow me the opportunity to wish each and everyone of our members a safe, happy and peaceful festive season. I hope that you are able to enjoy quality time together with family and friends over the Christmas and New Year holiday period, and I trust that you will be able to rest adequately before the onset of the 2019 work year with all its challenges and opportunities.

May 2018 be a memorable year for Operations Research in South Africa!

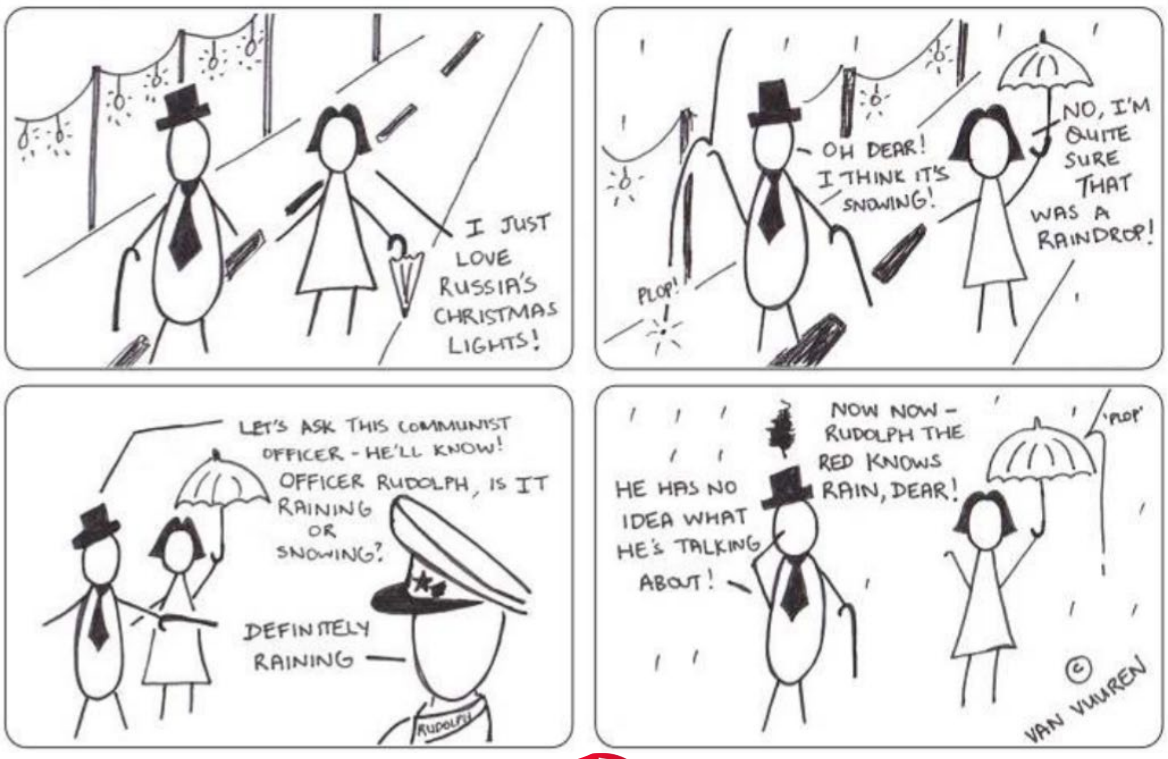
Daniel Lötter

HAVE YOUR SAY

The ORSSA Newsletter is an excellent medium for showcasing one's work or interests to the Operations Research community, not only in South Africa, but around the world.

Contributions of any nature are welcomed If you would like to submit material to the Newsletter, please send your article or review, along with all associated media (*e.g.* images, charts, *etc.*) to the editor at **brianjohnvanvuuren@gmail.com**

One from the ORSSA archives...



Getting to know the Vaal Triangle Chapter

Compiled by Philip Venter (12330825@nwu.ac.za)

Marius Smuts

Marius Smuts is the vice Vaal Triangle Chapter's vice-chair. In a recent conversation I asked the following OR related questions to him.

When did you first become interested in Operations Research?

I attended my first ORSSA conference in 2016 in Stellenbosch and during this conference it was incredible to see the type of work been done in the field of OR. The wide range of applications in the field of OR convinced me to do research within this field. Seeing that my background is in financial mathematics, I was very excited to learn that OR also have many applications within this field.

What is your current position at NWU's School of Mathematical and Statistical Sciences?

I am currently a lecturer in the Statistics department in the NWU's School of Mathematical and Statistical Sciences, where I teach courses in Introductory Statistics and Mathematical Statistics.

Which OR topic do you find most interesting and why?

I find the field of optimisation the most interesting. This is due to its many applications in the financial industry and the challenging mathematical problems it poses. Optimisation forms the core part of my PhD, which I started with two years ago.

Any OR-related project you've been involved in?

I did a project in conjunction with my PhD supervisor, Prof Fanie Terblanche, for a large retail bank in South Africa. I feel it is important to be regularly involved in industry related projects to help bridge the gap between pure academics and industry.

When did you become involved in the Chapter's activities and what motivates you to stay involved?

The ORRSA conferences that I attended in 2016-2018 motivated me to become part of this society and to join the Vaal chapter. The exiting developments in OR and its wide application keeps me interested in the field and, the opportunity that the OR society presents to interact and network with colleagues, motivates me to stay involved.

ADA LOVELACE DAY

Compiled by Gemma Dawson (gemmadawson@gmail.com) & Dave Evans (davevans@gmail.com)

Gemma Dawson

Ada Lovelace Day commemorates Ada Lovelace as an archetypal role model for women in STEM. (Science, Technology, Engineering and Maths.) It was initiated in Britain about 10 years ago and is now celebrated all round the world. The Joburg ORSSA Chapter celebrated it last year, and as far as we know, that was the first time this has ever been done in South Africa. It is the second Tuesday in October, which was the 9th, this year and again, as far as we know, ours was its only commemoration in Africa. We suggest that the other ORSSA chapters should join us in celebrating it in a year's time. She is sufficiently high profile that the UK is considering her as the 'face' that goes on their new £50 note!

Some 30 ORSSA, SAIIE and other people gathered at Discovery in Sandton for a fascinating evening. Many thanks to Discovery for making the venue available.
Ada was born in 1815, the daughter of the well known Victorian poet, Lord Byron. Her mother supported her interests in maths and sciences, most unusually for a woman in that era. She worked with Charles Babbage when he was developing his Analytic Engine, the world's first design for a (mechanical) computer, although it was never built to an extent which could be tested. Ada realized its potential for more than just calculating, and wrote the first algorithm for it, to be programmed on a type of punched cards, making her almost certainly the world's first computer programmer, a good century before there was a computer!
Sadly, she died before the age of forty, so any potential she had to take that work further died with her.

This year's Nobel prizes have just been announced, including some women, and Gemma Dawson, of the ORSSA Johannesburg Chapter, covered the 'misogyny' of the Nobel awards over the years. The statistics alone are bad enough, but the cold blooded way in which many women who deserved Nobel prizes were deliberately excluded, while their male co-workers (and in one case, husband!) got the prizes for their work, is shocking. Hopefully that is now improving.

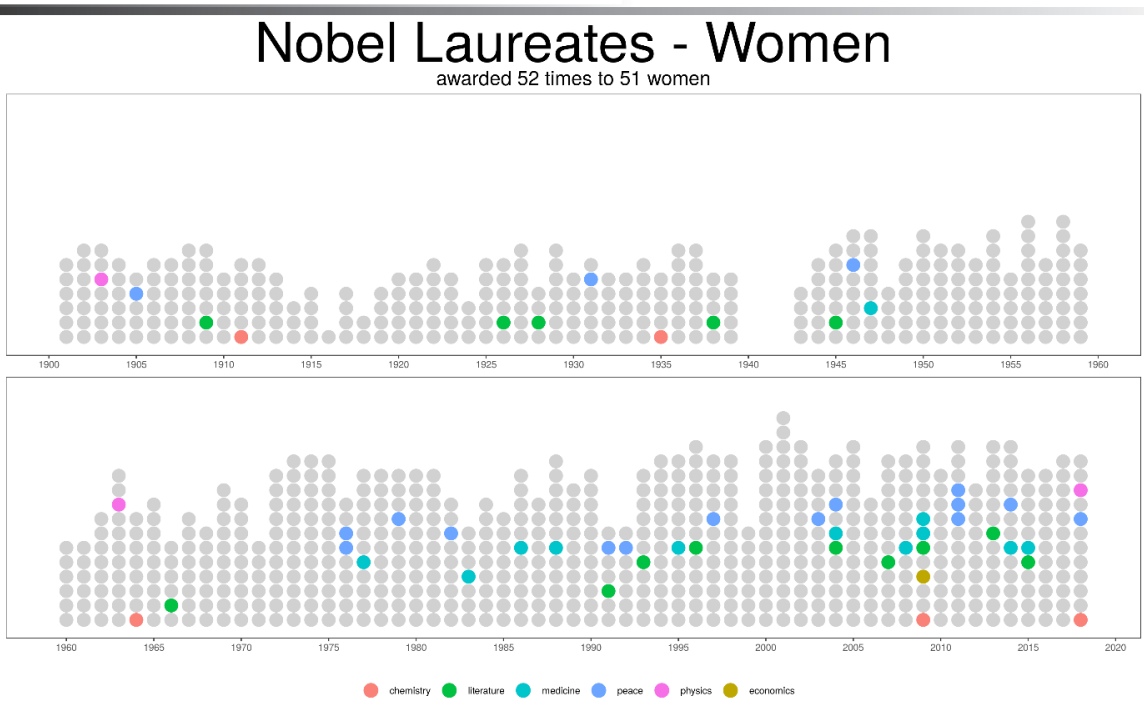
Several people of note with relevance for us in this context are:

- **Marie Curie** (Poland): The first woman to receive a Nobel prize (1903 Physics shared with her husband, Pierre Curie). Also the first person to receive a second Nobel with her unshared 1911 prize for Chemistry. She was the first woman to receive the Nobel chemistry award. She remains the only women to have won an unshared STEM award, as well as a second prize and the only person to win two STEM Nobel prizes.

Dave Evans

- **Gerty Cori** (USA): the first woman to receive the Physiology or Medicine Nobel. She shared the 1947 award which made her the third woman to receive a STEM Nobel award (after Curie & Irène Joliot-Curie)
- **Frances Arnold** (USA): most recent recipient of the chemistry Nobel prize. She shared the 2018 award with two men.
- **Donna Strickland** (Canada): the most recent recipient of the physics Nobel prize. She shared the 2018 award. This award makes her the only the third woman to receive the physics prize. In May 2018, Wikipedia had decided that her work was not important enough for her to be bestowed with the honour of a dedicated Wikipedia page: - https://qz.com/1410909/wikipedia-had-rejected-nobel-prize-winner-donna-strickland-because-she-wasnt-famous-enough/) .
- **Max Theiler** (South Africa): The first African-born recipient of the Nobel Prize: 1951 for Physiology or Medicine and first African-born recipient of a STEM prize.
- **Albert Luthuli** (South Africa): The first black African-born recipient of the Nobel Prize (1960 Peace prize.)
- **Nadine Gordimer** (South Africa): The first African-born woman recipient of a Nobel Prize (1991 literature prize.)
- **Wangari Maathai** (Kenya): The first black African-born woman recipient of a Nobel Prize (2004 Peace prize.)
- **Denis Mukwege** (Democratic Republic of the Congo): most recent African-born recipient of a Nobel Prize (2018 Peace prize.)
- **Sydney Brenner** (South Africa): most recent African-born recipient of a STEM Nobel Prize (2002 Physiology or Medicine prize.)
- **Dorothy Crowfoot Hodgkin** (United Kingdom): only African-born (Egypt) woman to receive a STEM Nobel prize (1964 Chemistry prize.)

The chart n the following page shows the number of female winners of Nobel prizes for each year, out of the total. Of the 904 awards to people (as opposed to organistions), only 52 have been to women, 20 of which were in the STEM subjects.



Our guest speaker was then Ridhwana Khan, an entrepreneur and software development consultant, who is a suitably modern role model for women in the STEM area.

As a software developer, she is constantly fulfilling her passion for finding solutions to problems that meaningfully impact people's lives. She was chosen as one of the '2018 Inspiring 50 women in STEM in South Africa'. She co-founded a software development company, Zero One Bespoke Software Development in 2015.

Ridhwana is involved in multiple activities that empower women in technology. She is a co-organiser of a Ladies that UX and Women in Tech meetup group that serves a support system for women to learn more about UX and to build meaningful relationships.

She gave us an excellent talk on her approach to problem solving: her first step is always a cup of coffee!
Ridhwana has a Bachelor of Science Degree, majoring in Computer Science and Applied Mathematics." Her twitter handle is @Ridhwana_K.

Chasing the Sun

Written by Fanie Terblanche (fanie.terblanche@nwu.ac.za)

Fanie Terblanche

Technological advances towards cleaner and sustainable energy have picked up momentum during the last decade as pressure mounts to cut carbon emissions and to reduce our dependency on fossil fuels. In South Africa, the escalating cost of electricity and fuel are additional factors that are stimulating the search for alternative energy sources.

The production of Electrical Vehicles (EVs) was initially considered to be economically less attractive due to limited battery capacity and the high cost of the underlying technology. The uptake in EVs has increased at a steady pace, see for example Figure 1, and the number of EVs on the road by 2030 is estimated to reach 125 million worldwide [1]. According to a study by Sivak and Schoettle of Michigan's Transportation Research Institute [2], the average cost of operating an EV in the US is $485 per annum, compared to $1, 117 per annum for operating a gasoline-powered vehicle. Although these statistics may not necessarily apply to other countries right now, the direction of the automotive industry worldwide to invest more in EV technology is encouraging.

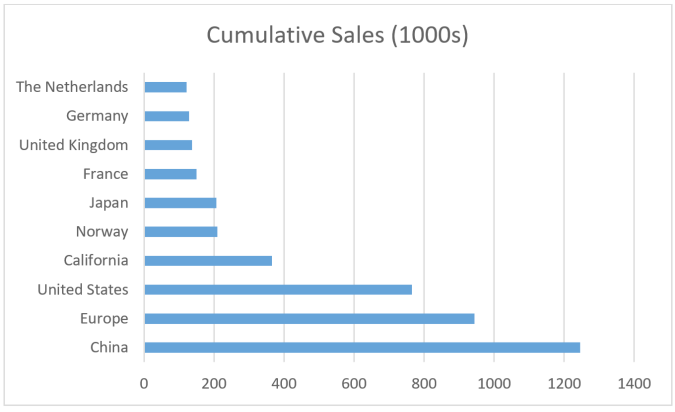


Figure 1: Top-selling light-duty plug-in electric vehicles up to December 2017 [3,4].

Current EV charging options are limited to either home charging or to make use of public charging stations. As expected, in countries with a higher number of EV sales, more public charging stations are available. Cost of charging may vary considerably from country to country, and the type of EV you drive may also play a role. For instance, if you own a Tesla, charging was free up until 2017. This attractive benefit to Tesla owners has since expired, and currently charging is priced according to the preferred speed of charging.

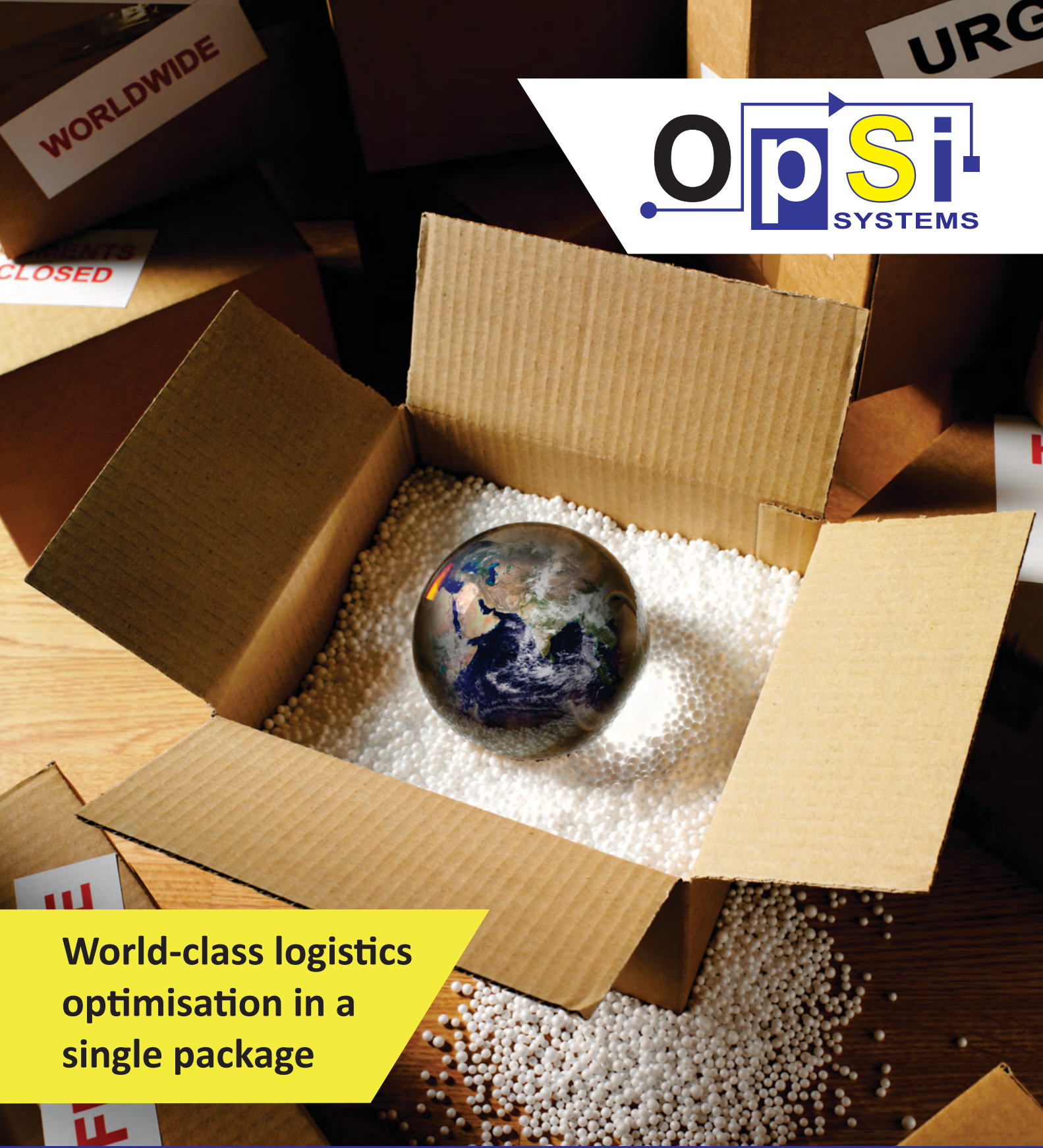
The question pondered by most potential EV owners, is whether it is economically worth-while to buy an EV? Other factors that make the decision even more complicated are, for instance, the range of an EV per charge and the availability of charging stations. These concerns are, probably, more prevalent in underdeveloped countries. In South Africa, only 0.2% of all vehicles sold since 2013 are electric, and there are still a minimal number of charging stations across the country. There are, however, reports in media of several projects to expand EV charging capability to South Africa's major hubs and along highways.

For EVs to become more affordable, greater effort has to go into research and development of EV technology. Apart from innovation in energy efficiency and aerodynamics, the potential use of solar energy should also be considered in the equation. With potentially different sources of energy, range capability and location of charging stations, route planning and optimal speed control will become an integrated part of any EV design.

Expanding EV research capacity, specifically within higher education, requires more than just expertise and passion. Funding is essential, but also an environment in which integrated development and testing may take place. Ideally, students should have access to a testbed in the form of an experimental EV for integrated research and development across all the different engineering disciplines. In South Africa, such a testbed is available to several universities in the form of experimental solar-powered vehicles. The initial motivation for South African universities to start building solar-powered vehicles was primarily due to the introduction of the Sasol Solar Challenge in 2008.

The Sasol Solar Challenge is an event that takes place every second year in South Africa with the purpose of showcasing the capability of solar-powered vehicles from all over the world. There are four race categories, each with different rules and objectives:

- Challenger Class – in this category solar-powered vehicles are newly built, four-wheel, single-seater cars, designed for optimum energy efficiency and endurance.
- Adventure Class – solar-powered vehicles in this class may have participated in previous editions of the race and may exceed certain specifications that are mandatory in the Challenger Class, for instance, larger solar arrays, three-wheel configurations, etc.
- Cruiser Class – in this category the objective is to enter vehicles designed for everyday practical use, for instance, they will typically have four seats and a storage compartment.



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- Sustainability Fleet – this category allows the automotive industry to showcase how photovoltaic technologies are incorporated into, petrol, diesel, hybrids and full battery EVs.

The route for the eight-day race event is from Pretoria to Cape Town and during each race day, racing teams may accumulate extra kilometres by completing as many loops as possible before reaching the finish line at 17:00. Therefore, apart from design and manufacturing skills, solar car teams participating in the Sasol Solar Challenge also need to outperform their rivals by determining an optimal racing strategy for the eight-day racing event. Such a racing strategy has to take into account factors like the weather, the road profile, and ultimately, the number of loops to complete for each day.

From an algorithmic point of view, building a race strategy optimisation system may at first seem like a routine application of some hybrid mathematical programming problem. This is of course also the part of the project that gets any Operations Research enthusiast jumping with excitement. It is indeed a very complicated optimisation problem, considering that any algorithmic approach will have to take into account, not just the energy characteristics of the vehicle, but also weather conditions, road profiles and the risk appetite of the racing team. However, the real challenge does not necessarily lie with the development of a super-intelligent algorithm that is capable of providing spot-on optimal results. The successful application of a race optimisation strategy relies heavily on proper data integration and the continuous calibration of optimisation models throughout the race. These are at least some of the lessons learned by the North-West University, solar car team.

Proper data integration does not only entail the reliable sharing of data among the subsystems of a solar-powered vehicle, but it also implies the correctness of the data that describes the characteristics of the car. For instance, to determine what the energy consumption of the drivetrain would be, given the current speed and road profile, a mathematical model, based on physical characteristics like the vehicle's drag coefficient and the rolling resistance of the tyres, is used. The race strategy optimisation model is sensitive to the correctness of the underlying models that describe the physical characteristics of the vehicle, and any anomalies in the latter may render the final optimisation results useless.

Since the solar car projects at the various educational institutions form part of postgraduate teaching, students from specific engineering disciplines typically work together on isolated parts of the solar car project. This highlights the importance of implementing a multi-disciplinary project management approach in order to ensure proper management of data integration. This is then also the type of valuable experience that students don't typically get as part of formal teaching.

Apart from the pedagogical advantages of participating in the Sasol Solar Challenge, the testbed in the form of solar-powered vehicles will hopefully also create a climate for EV research and innovation.

Pheonix, the solar car of North-West University, participating in the 2018 Sasol Solar Challenge.

References:

[1] https://www.cnbc.com/2018/05/30/electric-vehicles-will-grow-from-3-million-to-125-million-by-2030-iea.html

[2] http://www.umich.edu/~umtriswt/PDF/SWT-2018-1_Abstract_English.pdf

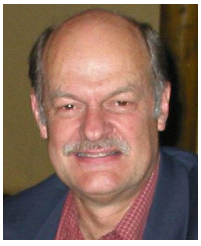
[3] https://www.hybridcars.com/the-world-just-bought-its-two-millionth-plug-in-car/

[4] *International Energy Agency (IEA), Clean Energy Ministerial, and Electric Vehicles Initiative (EVI) (June 2017). "Global EV Outlook 2017: Two million and counting" (PDF). IEA Publications. Retrieved 2018-01-20. See pp. 5–7, 12–22, 27–28, and Statistical annex, pp. 49–51*

Book Review: Prediction Machines

The simple economics of artificial intelligence

Written by Hans W. Ittmann (hittmann01@gmail.com)



Hans Ittmann

Artificial Intelligence (AI) has been developing for years, with the initial excitement about the potential possibilities, going as far back as the 1950s. A period of disillusionment followed. However, AI has now entered a critical stage in its development and adoption. Today AI is everywhere. It's in the phone you use, in the car you drive, it is in hospitals, banks, and all over the media. This has been made possible by improved techniques such as machine learning and deep learning, as well as the massive growth in available data and the increase in computer processing power. All of these have enabled AI to be deployed far more extensively than ever before. AI is about to fundamentally change businesses. How is this all going to pan out in future? Leaders, decision-makers as well as technologists, such as operations researchers, need to take note of these developments and the impact it could have.

The authors of *Prediction Machines*, all three prominent economists, have been close to many applications of AI. This has assisted them to focus on how this technology affects business strategy. Their first major insight was that AI does not actually contribute intelligence but instead, a critical component of intelligence, namely prediction. AI is a prediction technology, predictions are inputs to decision making, and economics provides for a prefect framework for understanding the trade-offs underlying any decisions. This is how the book, Prediction Machines came about, to form a bridge between the technologists and the business practitioner.

AI seemingly does the impossible but facing these can be nerve racking. What does AI mean for any business? How should companies go about setting strategies, how should governments design their policies, and how should individuals plan in a radically changing world? In the face of such uncertainty, the authors recast the rise of AI as a drop in the cost of predictions.

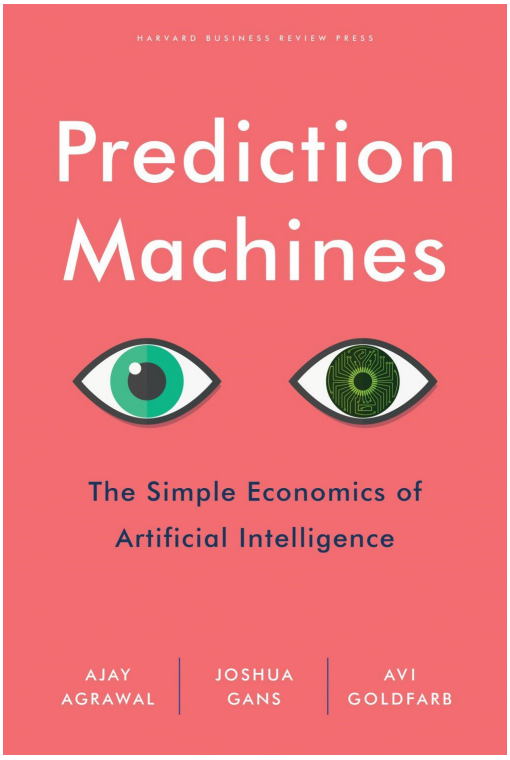
There are several examples given where the price of something became so cheap that is was used with abandon. Light, the Internet and autonomous vehicles are such examples. Using AI to predict the authors believe will follow a similar route. Buying books from Amazon is presented as such an example. Currently when one buys a book from Amazon the business model is shopping-then-shipping. At the same time Amazon's AI offers suggestions, based on past buying patterns, of items it predicts the buyer will want to buy. At present these suggestions are not very accurate. Imagine if the predictions can be improved to the point where it becomes profitable for Amazon to ship the item before receiving an order. Their business model will then change to shipping-then-shopping and both Amazon and the client will benefit! This point has not been reached yet. For this to happen improved predictions are needed. More data is needed to train the AI better, etc. etc.

What is presented in the book is not a recipe for success in the AI world. Instead trade-offs are emphasized. It is clearly stated that more data means less privacy, more speed means less accuracy and more autonomy means less control. No best strategy is provided. The best strategy for any company is dependent on how it weighs each side of every trade-off. Prediction Machines provides the structure for identifying the key trade-offs and how to evaluate the pros and cons to reach the best decisions.

The book is structured into five separate sections each reflecting a layer of impact from AI, namely, (1) *Prediction*, (2) *Decision Making*, (3) *Tools*, (4) *Strategy* and (5) *Society*.

This represents the five layers of a pyramid that is built from the foundations of prediction all the way up to the trade-offs for society. Each section consists of one or more chapters, many examples are used to illustrate and explain concepts while each chapter is concluded with key-points, or summaries of what is contained in the chapter.

Prediction is defined as the process of filling in missing information. It takes information one does have, called "data" and uses this data to generate information one does not have. The seemingly mundane process of filling in this missing data can make prediction machines seem magical. The goal of machine learning is operational effectiveness which is different than the goal of statistics. These prediction machines rely on data which is costly to collect. There is training data for training the AI, input data that is fed to the algorithm within the machine to enable predicting, then feedback data to improve the accuracy of the prediction. Machines and humans have distinct strengths and weaknesses in the context of prediction. The appropriate division of labour between these two are described through a very useful taxonomy of prediction.



In the second section, that deals with *decision making*, the role of prediction as an input into decision making is discussed together with another important component namely judgment. The difference between the two is clearly outlined. Prediction facilitates decisions by reducing uncertainty while judgment assigns value in the form of a payoff, a utility, reward, or profit. Prediction machines increase the value of judgement. It is shown that prediction is not a decision, it is only a component of a decision. One also needs judgment, action, outcome and the three types of data defined earlier. The value of judgment is dealt with in detail as well as the role humans play in the process.

A well know example, for operations researcher, from World War II is used to illustrate the limits in the ability of machines to predict human judgment. Bombers were lost during the war and, using the data of bombers that returned, the question was could the bombers be better armoured to reduce the loses? The bullet holes in the bombers that returned were the data. Were these the obvious places to better protect the planes? The expert came up with a counter intuitive solution – protect the places without bullets! The planes that did not return were most probably hit in these areas and they proved fatal! Machines are thus not good at predicting for rare events. In problem situations, where there is a high level of complexity, the ability of humans and machines to deal with these are highlighted. Humans tend to go for "satisficing" solutions, i.e. solutions that are not optimal but good enough. It will take a huge amount of practice to get machines to deal with such situations.

The section on AI *tools* focus on how to design prediction machines to perform specific tasks. It shown that that work flows will have to be decomposed to enable the allocation of tasks to a machine. The same applies for decisions that will have to be decomposed. For jobs, which are a collection of tasks, the implementation of AI tools to perform the job will imply: AI tools may augment jobs; AI tools may contract jobs; AI tools may lead to the reconstitution of jobs; and AI tools may shift the emphasis on the specific skills required for a job.

Section four deals with *strategy*. As shown by the Amazon example AI could have such a profound impact that it will transform the business or industry. In these circumstances it is critical that the C-suite of a company or organization gets involved.

In all AI interactions and debates the following questions, on how AI will affect society, keep being raised. These are discussed in section 5:

- Will there still be jobs? *Yes*.
- Will this generate more inequality? *Perhaps*.
- Will a few large companies control everything? *It depends.*
- How will countries react in terms of policies, people's privacy and security to give their domestic companies a competitive edge? *Some will.*
- Will the world end? *You still have plenty of time to derive value from the book.*

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Open Source Software: "Can Software be free?"

By Neil Manson *(neil.manson@infotech.monash.edu)*

"How can software be free? I've always thought that there is no such thing as a free lunch."

"Well, the word 'Free' in 'Free Software' doesn't mean the price. It refers to the freedoms that Free Software gives its users. However, many Free Software programs are also available at no cost."

"What Freedoms?"

"The Free Software Foundation defines Free Software as software that is distributed under a licence that guarantees four basic freedoms. These are the freedom to run the program for any purpose; the freedom to study how the program works, and adapt it to your needs; the freedom to give away copies so you can help your neighbour; and the freedom to improve the program, and to make your improvements available to the public, so that the whole community benefits.
Essentially, Free Software is software that is distributed with the source code, so you can look at how it works, and make changes if you need to."

"I've also heard of 'Open Source Software'. Is this different?"

"Yes, it is slightly different, but it is also the same in many ways. The main difference is that if you make a modification to a piece of Free Software, and distribute it, it must also be Free Software, but this is not a requirement of Open Source software.
Both of these are very different from traditional proprietary or Closed Source Software. Proprietary software producers generally keep the source code completely secret, and their licences explicitly prevent the user from attempting to change it, or from giving away copies."

"So why is Free Software a good thing?"

"There are many reasons. Probably the main advantage of free software is the superior quality and reliability. This comes from the fact that you have many people looking at the source code. The more people who look at a piece of work, the more likely any mistakes or problems are to be detected.
Another big advantage is the development speed. Free software projects tend to release new versions fairly frequently which allow the developers to listen to their users, and rapidly incorporate suggestions and feature requests."

"But doesn't that mean that the user has to upgrade their software often?"

"It can do, if you want to be on the leading edge, and always have the latest features. However, it doesn't have to. Many Free Software projects work in two branches, commonly called the stable branch, and the development branch. The development branch releases new versions frequently so that users can test them and give feedback. These evolve quickly, but do tend to be a little unstable and buggy. The stable branch only releases new versions much less frequently, and they include changes that have been well tested and are working correctly. If you need stability more than the latest features, then you would use the stable branch."

"What about some specific advantages?"

"Well, there are some specific advantages for developing economies, such as reduced dollar based costs, because most Free Software is available at no cost. Access to the source code also allows customization for local requirements. A good example of this is Translate.org.za who has translated the Open Office suite into Afrikaans, Zulu, Sepedi, and Tswana.
Another advantage for developing economies is the freedom from dependence on foreign suppliers. Because they have access to the source code, local suppliers and developers can support and enhance the products. This can result in a stimulation of the local IT sector, including development, support and training.
Also, it is part of the job of a government to store, manage and make available public information such as policy documents. The society will have much greater access to this information if it is available in a standard format that can be read by software that anyone can get."

"You are a lecturer. How does free software affect your environment?"

"Obviously, one of the main factors is the cost, both for the school or university and for the students. There is also the reduced burden of license management. This is not just a theoretical problem. In the US, Temple University was fined $100k and the LA Unified School District was fined $300k for not complying with license agreements, not because they were deliberately trying to avoid license fees, but just because they hadn't managed it adequately.
A big problem in schools is viruses. However, Free Software, and particularly the Free Operating System GNU/Linux, is much less susceptible to viruses.
Also, having access to the source code can be used as a teaching tool. It is very useful for students to learn good programming techniques and practices by looking at the code that other professional programmers have written."

"How does free software apply to Operations Pesearch?"

"There are some repositories of Free OR software. The COIR-OR repository has a collection of optimization and other software. The GNU project also hosts a linear programming kit. There are also projects that have been released through general repositories such as the Distributed Simulation Object Library (DSOL) released on SourceForge.net."

"What about support? If there is no company responsible for producing the software, who can you go to for support?"

"Support is an interesting issue. In some places you will read that support for Free Software is difficult to obtain, and in others you will hear that it is better than the support for proprietary software. The reason for this is that support for Free Software is available in a slightly different manner than what most people are used to in a proprietary environment. Support comes from the other users and the developers of the software through newsgroups, mailing lists and web forums. You have to go online and either ask a question, or search through previous questions and answers. It sometimes takes a little while, but you can almost always get the information you need. Often you can email the developers directly, and they will actually respond. A big thing about the support for Free Software is that you are not dependant on the original vendor, as you are with most proprietary software."

"And security? Surely making the source code available to anybody makes it easier for the bad guys to find holes and vulnerabilities in the program?"

"Yes, it does, but at the same time it makes it possible for good guys to find holes and to fix them. As we've seen from proprietary software, the bad guys don't need the source code to exploit holes. With Free Software you have many developers looking at the source code, so you have a much better chance that bugs will be found and fixed. Also, you are not dependant on the vendor to fix a discovered problem – which may take a while. Some time ago an exploit called the 'Ping-o-Death' affected both proprietary and free software. It took the proprietary developers months to release a patch, whereas the free software developers had a patch available within hours."

"Isn't it hard to use? I've always thought of Free Software as something used by programming geeks."

"Yes, it used to be true that Free Software was hard. However things have changed radically in the past few years. Most Free Software now comes with simple installers and easy-to-use graphical interfaces. Even the GNU/Linux operating system comes with a choice of interfaces, such as the Gnome Desktop that I am running here on my Linux box (see Figure 1)."

"This all sounds very good but surely there must be some problems with free software?"

"Yes, unfortunately there are. Many applications are still written by developers for other developers and are not that user friendly. Interoperability with other proprietary software can be a problem, although often it is not. Free Software doesn't have the marketing effort that proprietary software enjoys, so many people don't know about it. Also, because you get the software and the support from the Internet, you need a fairly good Internet connection, which is not available in many parts of Africa.
Although these are real problems, things have changed dramatically from where they were just a few years ago, and they will continue to change for the better."

"I don't think I'm ready to move to a free software operating system yet, but can I start using some free software in my Windows environment?"

"There are many Free Software programs that are available for Windows. For example, on my Windows box I use OpenOffice for writing documents, doing spreadsheet calculations and preparing presentations (see Figure 2). I use Mozilla to browse the web and to read email."

"This all sounds very interesting. Where can I find more information, and where can I get some Free Software to try?"

"Well, I've set up a page with some links on the ORSSA website. It's available at http://www.orssa.org.za/links/Free_and_Open_Source_Resources.html"
"Thanks a lot. I'm off to check it out. See you later."
"Cheers!" ♦

Figure 1: The Gnome Desktop on GNU/Linux

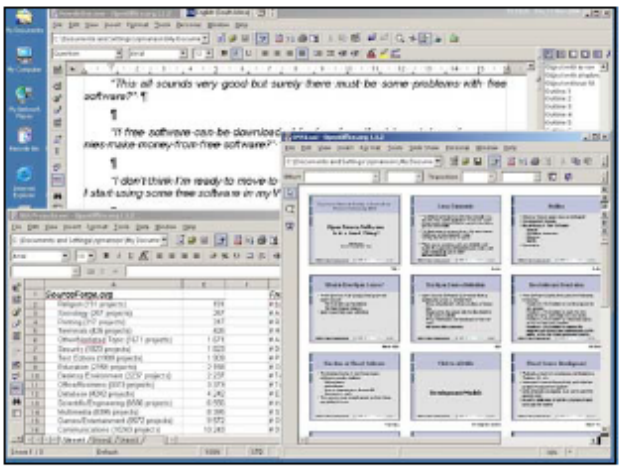

Figure 2: Open Office on Windows