Newsletter

Operations Research Society of South Africa

Operasionele Navorsingsvereniging van Suid-Afrika

"...the helpline has developed a reputation of being slow to respond or unreachable, unacceptable in the views of paying customers. This has lead to the company investigating ways to improve their service..."

March 2008

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FROM THE EDITOR

Welcome to the first edition of the ORSSA newsletter in 2008! I'm sure many of you are taking advantage of as many long weekends as possible this time of year, but if you are short of reading material it would be well worth your while to take the time and have a look at some of the excellent contributions from our members this month.

Basie Kok

Firstly I interviewed one of our societies greats, Hans Ittmann, regarding his current position as newsletter editor for the IFORS newsletter, and as can be expected received some invaluable insights into the field of OR on a global scale.

Our main article this month is entitled "*Service level optimisation of a telephonic helpline*", submitted by Mia Meyer. The article covers work she completed during her *BSc. (Hons)* degree under the supervision of Prof JA Wolfaardt at the Department of Decision Sciences, University of South Africa. It promises to be an excellent read!

The first "*Off the presidents desk*" from our new president, Sarma Yadavalli, provides an appropriately vibrant introduction to the year, and mention of the upcoming IFORS conference sets the stage for an exciting 2008.

I decided to start a new newsletter column this issue, entitled "OR anecdotes", and our first contributer, Philip Fourie, provides an amusing account of a PhD dissertation.

I sincerely hope you enjoy this issue and continue to embrace and extend the fascinating field of OR to all around you during 2008!

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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**.

PMS 2008 ELEVENTH INTERNATIONAL WORKSHOP ON PROJECT MANAGEMENT AND SCHEDULING

April 28 - 30, 2008 ISTANBUL (TURKEY)
EURO Working Group on Project Management and Scheduling

http://pms2008.boun.edu.tr/

ABSTRACT SUBMISSION

Extended abstracts of not more than 4 single-spaced A4 pages written using font size 11 in either Microsoft Word or PDF format must be submitted electronically. Please check the conference web site for details. All abstracts submitted will undergo a peer review process, and abstracts accepted will be published in the workshop proceedings available at the workshop. The first name will be taken as the corresponding author unless otherwise requested.

IMPORTANT DATES

Deadline of submission for 4-page abstracts	November 26, 2007
Notification of acceptance	December 26, 2007
Deadline for final version of 4-page abstracts	January 21, 2008
Early registration deadline	February 15, 2008

Please note that at least one of the authors should be registered by the early registration deadline for the abstract to be published in the proceedings.

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FROM THE PRESIDENT'S DESK

by Sarma Yadavalli (yadavalli@postino.up.ac.za)
ORSSA President

Sarma Yadavalli

Firstly I take this opportunity to thank the entire Operations Research (OR) fraternity for affirming their faith in me to serve as President for the year 2008. The uncontested continuation of Marthi Harmse Wim Gevers, Isabelle Nieuwoudt, Jan van Vuuren, Stephan Visagie, Basie Kok, Johan Joubert, Ozais Ncube, Neil Manson, and Margerete Bester as members of Executive committee gives me a still happier feeling that the members have continued faith in the present Executive Committee and permit many of us to continue to serve. I am sure, their rich experience in different positions in ORSSA in the earlier years will be extremely beneficial in the current year. Also, I need the support and cooperation of all the members of ORSSA, which I am sure, I will get. My sincere thanks to Marthi, the outgoing President for her services, and I seek the cooperation from Marthi in future as well.

In my opinion, the OR scene in South Africa is very vibrant. As a subject or discipline taught in all local universities and University of Technologies, OR(or Management Science) has always been popular with students. Graduate OR and OR-related degree programs in South Africa are very well subscribed too (Industrial Engineering, Logistics departments etc.). In our own department (Industrial Engineering) at University of Pretoria, OR modules are core modules, and the majority of the students use the OR techniques in their final year projects.

It is easy to appreciate why OR is so popular– it is primarily due to the practical, and scientific approach. In fact many large organizations in South Africa, both in government and in industry, have embraced OR as one of their strategic core competencies (Department of Trade and Industry, CSIR, Banking sector, SASOL etc). To promote OR, Management and Decision Sciences in South Africa, we need to introduce technical talks, industrial visits and a competition for secondary school students.

We need the Society to be strong in order to achieve its objective as well as to gain better recognition for our profession. Thus, top on the list of priorities of the Committee is to promote and expand the ORSSA membership. However, the Committee will not be able to achieve its aim without the strong support of its existing members. So, we need each and every member of ORSSA to help spread the message.

This is a totally different, yet very exciting year. The international OR community are also celebrating the 50th Birthday of the International Federation of Operations Research Society (IFORS), and the conference of IFORS 2008 will be held at Sandton Convention Centre, South Africa, the first on the African continent. I gratefully acknowledge the support for the sponsorship by UNISA, Statistics South Africa, Development Bank of Southern Africa, NRF, CSIR and DST. The local organizing committee (Hans Ittmann, Marthi Harmse, Theo Styliandes, Dave Evans and myself) is also working very hard to get sponsorships from government and industries. We are still seeking potential sponsors for this conference. We must make this conference a great success.

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.

Early Registration : 1 March - 30 April 2008
Regular Registration : 1 May - 30 June 2008
Student Registration : 1 July 2007 - 30 June 2008

http://www.ifors2008.org

proudly hosted by ORSSA

MEMBER INTERVIEW: HANS ITTMANN

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

Hans Ittmann

Hans Ittmann is currently Manager of the Centre for Logistics and Decision Support, Division of Information and Communications Technology at the CSIR. Before starting his illustrious career at the CSIR in 1973 he served in the South African Air Force as a pilot. During his years in service he obtained a B.Mil.(B.Sc.) degree, later furthering it with an honours and masters degree in operations research. Hans has been a very active member of the society since he joined in 1973. In this period he has served as secretary and chairman of the Pretoria chapter, treasurer and additional member on the executive, business manager of Orion, and finished his second term as president in 2004 (the first term being in 1986). Hans has also made some substantial contributions to OR in South Africa leading to him winning the Tom Rozwadowski Medal on two occasions. He has represented the society in the international arena well over the years and more recently has been appointed newsletter editor of the International Federation of Operations Research Societies (IFORS).

How long have you been involved in the field of OR and what aspect of it do you feel most passionately about?

My association with OR goes back to the early 1970s when I started my OR studies through UNISA. I am passionate about the discipline itself because it can be applied in almost any sphere of life but, what I enjoy most, is convincing people who have a problem that it can potentially be addressed through our scientific approach to problem solving. This holds especially true when it is a new potential client in a totally new domain for me.

What is IFORS, how is it structured and what is the main goals/values/mission statement of the federation globally?

IFORS is the International Federation of Operational Research Societies which is an umbrella organisation comprising the national Operations Research societies of forty eight countries from four geographical groupings namely: Asia Pacific, Europe, North America and South America. The main goals of IFORS are the following and this I retrieved from the IFORS website (www.ifors.org):

The objects of the Federation (IFORS) shall be the development of operational research as a unified science and its advancement in all nations of the world. Means to this end shall be determined by the Federation in the manner outlined herein and shall include:

1. *Sponsoring of international conferences and meetings.*
2. *Providing other means for the exchange of information on operational research between nations.*
3. *Encouraging the establishment of national operational research societies.*
4. *Maintaining standards of competence in operational research.*
5. *Encouraging the teaching of operational research.*
6. *Promoting the development of specific parts of operational research and to encourage the development of new fields.*

When did you get involved in IFORS and what made you feel it was a worthwhile endeavour?

My first exposure to IFORS was in 1984 when I attended the 10th Triennial IFORS Conference in Washington DC. I have subsequently attended all the IFORS conferences. At these conferences, there were sessions on the topic of OR in Developing Countries which I always tried to attend. In May 2001, we organised the ICORD Conference (International Conference on OR in Development) in the Kruger National Park. Not long afterwards, I was asked if I would like to take over the editorship of the IFORS newsletter for Developing Countries. This happened in 2003. Why did I get involved? I enjoy being actively involved in different endeavours and this seemed a way to contribute to OR in developing countries. It also gave me the opportunity to get to know international OR people and personalities.

Could you give us a brief overview of the values and mission statement of IFORS with respect to Africa?

I am not sure about a formal mission statement and values that IFORS has for Africa. What I do know is that over the last number of years, there has been an active effort from IFORS and other societies to mobilise OR activities in Africa. There has been a strong focus on establishing contact with local OR people, on organising conferences in various parts of Africa, most of these sponsored by IFORS, as well as getting formal societies established in African countries and regions. Personally, I was partially involved in Eastern Africa by assisting OR people from Kenya, Tanzania and Uganda to get their activities going and establishing a regional society.

The upcoming IFORS conference in Johannesburg is an exciting development in terms of the global OR community's awareness and dialog with ORSSA and other African related OR bodies. What do you think ORSSA members can do to take full advantage of the event, and ensure that the opportunity yields benefits well into the future?

IFORS 2008 is indeed a wonderful opportunity to show case, not only South Africa, but Africa in general to the international OR community. ORSSA members need to present as much of their work at the Conference as possible because in this way, we will show case the high quality work that is being done by our members. This will give us international exposure as well as open doors for international

collaboration, co-operation and networking. To me, this has been the value of conferences, and ORSSA members can benefit hugely by ensuring they meet international delegates, interact and discuss mutual interests as far as OR work is concerned and the rest will virtually happen automatically. This Conference will allow ORSSA members to gain exposure by meeting many well known international OR personalities. Although it may not always seem so, they are also keen to interact with people from the host country. Let us all therefore use this great opportunity.

In your current capacity as editor of the IFORS newsletter you seek out and receive many contributions from all over the world from many different facets of IFORS and member societies. What has been the most exciting development either of the body itself, or of OR in general that you have come across recently?

The IFORS newsletter started in June of 2007 and my biggest task is to approach people to submit articles and contributions. It would be great to be in a position to receive the "many contributions" as you mention. What I find exciting, however, is the way in which people have responded when I approach them to contribute to the newsletter. In the majority of cases, people are more than willing to contribute and share their work through this newsletter. Through this newsletter, IFORS is trying to reach out to all its member societies and the members thereof. In this way, it endeavours to become a truly international communication vehicle and I believe that is exciting. If my efforts can play a small role in achieving this, I would be very grateful.

Your position at the CSIR provides no doubt much insight into the application of OR in an African context. Has your exposure to international OR, through your involvement with IFORS, provided any insights into how we can address the challenges of our continent?

Let me start off by saying that we, in South Africa, should not feel that we do inferior work in relation to what is being done elsewhere in the world. This is one thing that I always notice when I attend conferences outside of South Africa and that is the high standard and quality of the local OR work. We don't need to stand back! The one thing that stands out for me as far as Africa is concerned is the multitude, variety and complexity of problems that this continent faces. The majority of these problems can be addressed by OR whether it is through the traditional hard or soft OR approaches. What is, however, clear is that the funding of such projects will more than likely be problematic and usually one needs to find a funding agency to support such projects.

What do you think we as African OR practitioners can offer our colleagues from overseas either in terms of our work ethic or our approach to OR and the application thereof?

This is a difficult one for me. I believe we need to visibly show that we are on par with the rest of the world in all aspects of our OR work and involvement. In addition, the one thing that we can offer is involvement in problems that are specific to Africa. Although I am aware of the various efforts around this by the different institutions in South Africa, I personally do no think that we do enough in this regard.

Are you optimistic about the role ORSSA play globally and locally, and where would you like to see the society in 10 years time?

I am an optimist by nature and sincerely believe that ORSSA, through its members, can grow its involvement locally and specifically in Southern Africa. Internationally, more of the ORSSA members should get involved in IFORS activities through some of their summer schools, as well as the various activities of especially EURO. In this way, we can grow our international exposure which I believe can only be beneficial to members. Where should ORSSA be in ten years time? Here I think we need to market OR more actively and continuously amongst the entire school population in order for us to attract more and more young people and, in particular, black youngsters. In this way, ORSSA can become much more inclusive in the next ten years.

1st International Conference on Applied Operational Research (ICAOR'08)

15-17 September 2008

American University of Armenia
Yerevan, Armenia

Abstract

The conference is a yearly forum which brings together academics and practitioners from around the world with an opportunity to discuss current issues in an informal setting. The ICAOR 2008 conference will take place at American University of Armenia (AUA) in the city of Yerevan. We invite you to join your colleagues for this international meeting.

Important Dates

15-Sep-07 - Submission opens
15-Apr-08 - Paper submission deadline
31-May-08 - Notification of decisions
10-Jun-08 - Registration deadline
30-Jun-08 - Camera-ready deadline
15-Sep-08 - Conference starts

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OR Anecdotes

by Philip Fourie (pdfourie@sun.ac.za)

Russell Ackoff (1919 -) is one of the last remaining members of the first generation of OR practitioners. He is co-author of two of the earliest OR textbooks [1,2], both still very much worth reading. In a paper published on the occasion of his 80th birthday [3], he had some memorable things to say about his approach to OR:

"I'm going to recall the principal sources of the fun that I have experienced. First, the fun derived from denying the obvious and exploring the consequences of doing so. In most cases, I have found the obvious to be wrong.....My second source of fun has been the revelation that most large social systems are pursuing objectives other than the ones they proclaim and that the ones they pursue are wrong".

Some of his best writing is to be found in a small volume on management, consisting of 52 essays [4]. I suggested to the editor that it might be both amusing and edifying for readers of the Newsletter to be exposed to some excerpts. The first essay I have chosen is entitled "Jargon".

"Jargon is noise that keeps our brains from understanding what our mouths are saying".

...A while back I had a brilliant student who wrote a highly technical doctoral thesis on which he was examined by a committee of five faculty members. I chaired that session.

It was apparent from the beginning of the examination that the candidate knew more about the subject of his thesis than any of his examiners. He answered our questions with a display of technical pyrotechnics that left us in awe.

As chairman I was the last to question him. I asked him to assume that I was an ordinary corporate manager who wanted to know what his thesis was about. Would he please explain it to me briefly?

He went to the blackboard and began to cover it with mathematical symbols. I stopped him to remind him that I was an ordinary manager, not a mathematician. "Oh", he said, "that kind of manager." He stood thoughtfully for a moment, then started over, but once again resorted to mathematical jargon. This time he stopped himself. After a long pause he said, "I'm sorry, but I can't do it. The thesis is too technical to be explained in nontechnical language."

"No", I said, "I think there's a different reason." After some thought he said, "I guess I can't do it because I don't understand what I've done well enough to explain it in nontechnical language." This time he was right.

...Unless people can express themselves well in ordinary English, they don't know what they are talking about. It is only in ordinary English that we can communicate effectively with others and with ourselves. Communicating with ourselves is the most important kind of communication.

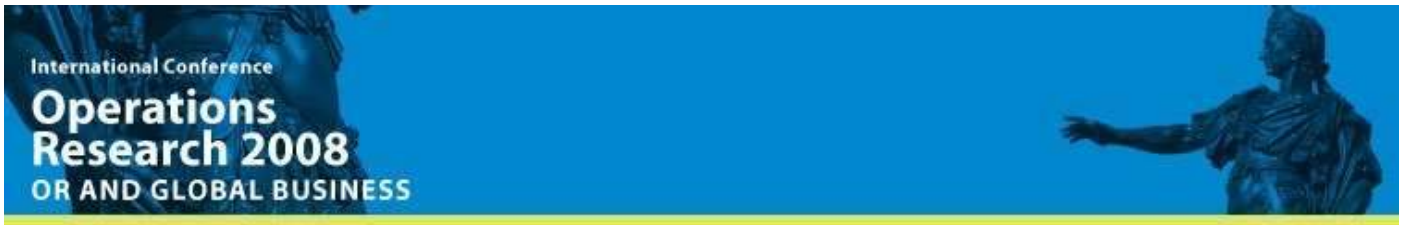
References

[1] Churchman, Ackoff and Arnoff, "Introduction to Operations Research", Wiley International, 1957.

[2] Ackoff and Sasieni, "Fundamentals of Operations Research", John Wiley and Sons, 1968.

[3] Ackoff, RL, "On passing through 80", Systemic Practice and Action Research 1999

[4] Ackoff, RL. "Management in small doses". John Wiley and Sons, 1986.



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/

Nedbank reduces time to intelligence by 1000 times with SAS SPDS

Financial giant Nedbank has managed to dramatically reduce the time to information of its Business Intelligence (BI) and Analytics systems, with the deployment of SAS Scalable Performance Data Server (SPDS).

The Business Case

Nedbank was facing a challenge in that it was taking in excess of 13 hours to access and draw data from SAS datasets in order to generate a mart from a star schema, which the users would then use to do queries with, via Enterprise Guide. This translated to a massive delay in reporting, making real-time BI and Analytics just about impossible. After calling on its BI partner SAS Institute to investigate the issues that may be causing the problems, SAS suggested that it try deploying the SPDS technology in the Nedbank environment.

"In all honesty we were asking a lot from a relatively underpowered technology environment, but when it takes more than 13 hours to get to the data you need to, its just not intelligence," says Christo Toerien, Group Technology Executive: Data Warehouse Infrastructure at Nedbank. "That said we called on the team at SAS to come and help us formulate a solution, using the technology we had, without reinventing and redesigning the entire system."

The challenge

With time to data from the Nedbank Debt Manager being what it was, SAS and Nedbank had to bring the time to construct the data view using the ETL tools down. Some challenges facing the project included the fact that both the Analytics and BI tasks had to be done off the same server.

Says Nicholas Eayrs, Manager – EMEA Solution & Technology Innovation Centre at SAS Institute Global: "The Nedbank situation was not unique but it was challenging. The company currently runs IBM pSeries hardware and the particular system we were working with was running on the back of a SAS dataset, and needed the capability to be able to update a dataset while it was being queried. We had a quad processor dual core partition to work with and needed to reduce the time to intelligence while at the same time ensuring that we didn't impact the Total Cost of Ownership of the infrastructure footprint."

The technology

With very little time at hand, it was identified that Nedbank already had SPDS as part of the Old Mutual Group enterprise licensing agreement, and this could be used to address the data access issues. The team quickly swapped the data store from the SAS dataset to the SPDS subsystem. Instead of creating a separate mart, a view on the star schema was created reducing the previous 13 hours it took to transact with the system to mere seconds. All of this while at the same time keeping the high performance we required from a reporting perspective.

SPDS is a native tool to SAS, which serves large numbers of concurrent users through the use of parallel processing and data server capabilities, it offers both vertical (user and queries) and horizontal (data volume) scalability. The technology is optimised to deliver subsets of information that need to be harvested from large enterprise data mountains on demand.

The solution

Says Adrian Mattioli, EDW Infrastructure Manager at Nedbank: "SPDS was rolled out in as little as three days for development and as little as 10 minutes for Query and Analysis and Production once the configuration could be duplicated this dramatically reduced the amount of time it takes for us to access our data, and what is even better is that we have not had to purchase any additional hardware or software to make it happen. It truly completes our Intelligence Storage Offering."

When installed SPDS simply embeds itself and just acts as an interface within your system, integration is seamless and it can work with just about any open standard database. Nedbank is now able to take advantage of the fact that its BI and Analytics applications maintain consistent performance and that ETL processes do not exceed the time available as the amount of your enterprise data continues to grow.

Benefits include:

* Significantly speed up the gathering of subset information with the use of parallel storage technologies and hardware.
* Optimised performance for both business and analytics applications, through a single integrated platform.
* Reduction in extraction, transformation and loading times.
* The ability to connect to data from different servers
* Data compression has enabled it to save storage space and also speed up processing.

To end

"Nedbank was given a fully functional system which supports the business aims of the organisation, in just on three days. It is cases like these which highlight the fact that sometimes the intelligent use of what you already have, can solve your technology challenges without having to spend more money on additional software and hardware to support your business aims," ends Eayrs.

"Its all about more for less and bridging that gap from time to intelligence."

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Service Level Optimisation of a Telephonic Helpline

by Mia Meyer (meymia@gmail.com)

This article focuses on work done by Mia Meyer for her BSc.(Hons) in Operations Research through the University of South Africa (UNISA). She studied under the supervision of Prof. JA Wolfaardt of the Department of Decision Sciences. It is to be noted that the original text was written in Afrikaans and this article is available in Afrikaans on the ORSSA website at

www.orssa.org.za/newsletter/mar08/

BACKGROUND

A South African telecommunications company uses a telephonic helpline as an error reporting service for their ADSL ("Asymmetrical Digital Subscriber Line") customers. ADSL is a high speed digital transmission technology, which utilises the already in place telephonic infrastructure.

ADSL is the flagship product of the company, and the customer base has grown exponentially in recent months, incurring high volumes of traffic at the helpline. Unfortunately this has led to the helpline having a reputation for being slow to respond, often unacceptable in the views of many customers. This has lead to the company investigating ways to improve their service, and in particular to analyse and optimise their ADSL helpline.

The objective of this project is to improve the service level of the helpline as much as possible whilst minimising the costs incurred in doing so, in terms of extra personnel employed etc.

SYSTEM OVERVIEW

New calls which arrive at the system are answered by the first available helpline agent. If none are available, the customer is placed in a first-in-first-out queue. If 120 customers are already waiting in the queue, the current customer is sent a busy tone.

A sophisticated helpline system, consisting of specialised hardware and software components, collects system activity data. Data collected includes the time a customer entered the system, the length of time spent in the system before a call was answered as well as the length of the call itself. Consequently there is sufficient data available to analyse the system and attempt to identify system failures and points of high improvement potential. Data was made available from 1st January 2007 – 31st July 2007. Although the fidelity of data available for analysis was very high, for the purposes of an overall system evaluation, average values were often used throughout the study. The reader must bear in mind that as a direct consequence, data values used during the study may differ from the actual values in the system at a specific point in time.

The time that a customer spends in the system before their call is answered is known as the *waiting time*. The time that the agent spends speaking to the customer is referred to as the *service time*. The inter-arrival times are the time periods between consecutive customers arriving in the system (calling the helpline). The number of customers who call the helpline within a given timeframe is known as the *arrival rate*. The number of calls handled by a given agent or by the helpline as a whole within a certain time frame is known as the *service rate*. The *loss rate* is the number of customers who left the system within a certain time frame (before their call was answered).

The company would like the helpline to adhere to the 80:20 rule, namely that 80% of calls must be answered within 20s for a 24h period, an international standard for acceptable helpline service. In order to establish the current state of affairs within the system, the arrival rate, service rate, and loss rate were investigated for a 24h period of helpline operation, with data being sampled every 30 minutes. This information is presented in Figure 1.

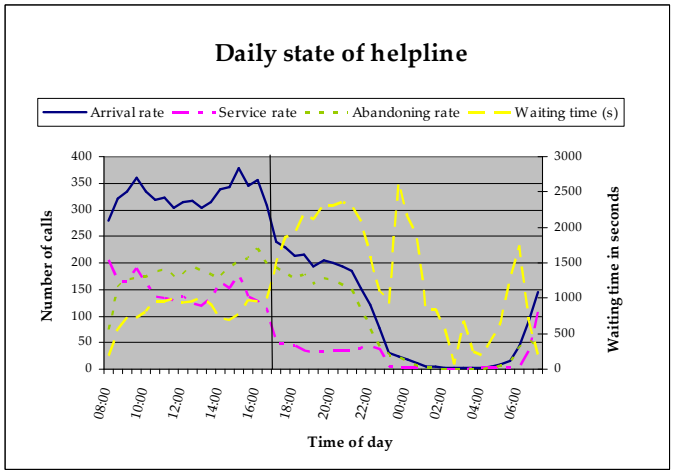

Figure 1: Daily helpline performance.

Arrival rate

The helpline is operational 24 hours a day. An average of 60 helpline agents are on duty during business hours (08:00 – 17:00), and an average of 24 agents after hours. There is a significant difference between the data collected during business hours and the data collected after hours. Incoming calls drop by 22% during 17:00 – 17:30 and thereafter decrease approximately linearly until an incoming call frequency of 13 calls per half hour is reached between 02:00 – 04:00. From 06:00, incoming calls increase dramatically.

Waiting time and loss rate

The average waiting time during business hours is 13min 41seconds, and only 44% of calls are answered. After-hours 22min 39s and only 28% of calls are answered. Figure 2 shows the percentage of calls that were lost in relation to the average waiting time and, as expected, there are strong positive correlations between the times consumers spend waiting and the number of them that leave the system before their calls are answered.

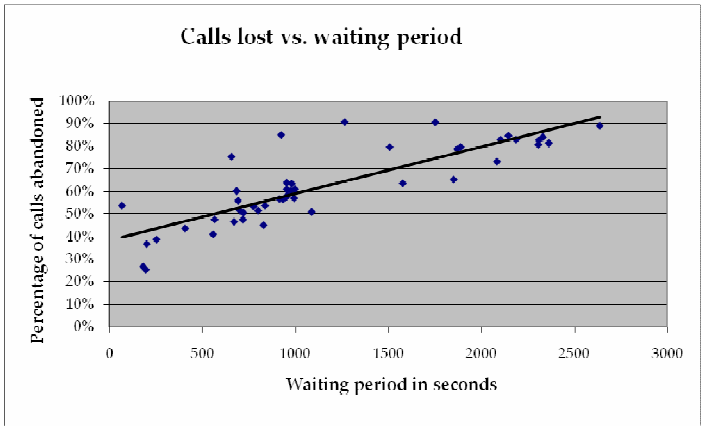

Figure 2: Correlation between the number of calls lost and the waiting time of customers.

A summary of the current status of the helpline is shown in Table 1. It is clear that the system is not operating effectively, and fails to live up to the standards required for acceptable customer service. Drastic measures need to be implemented as soon as possible, and one of the goals of this project is to identify the most effective changes to make.

	Office Hours	After Hours
Arrival rate per hour	637	171
Service rate per hour	326	100
Average waiting time	13 min 41s	22 min 39s
Percentage calls answered	44 %	28 %
Average number of agents	60	24
Average service time	11 min 2s	14 min 24s

Table 1: Summary of helpline statistics.

QUEUING THEORY MODEL

The helpline can be modelled as a queuing model if incoming calls are considered to be arrivals and the service offered is seen as answering the call and addressing the customers' needs. Each helpline agent is then considered a server, which services an arrival. The *state of the system* is considered to be the total number of customers in the system, including those in the queue as well as those speaking with an agent.

Inter-arrival times

The inter-arrival times can be described as the time periods between consecutive calls to the helpline. Inter-arrival times extracted from the data are shown in Figure 3.

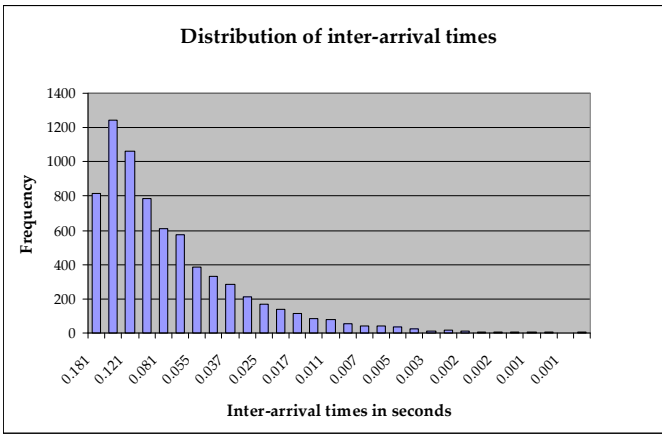

Figure 3: Inter-arrival times.

It is clear that an exponential curve is evident and fitting techniques suggest conclusively that an exponential distribution could be used to describe inter-arrival times. It is notable however, that the extrapolated data deviates from the exponential distribution for inter-arrival times greater than 0.121s.

Service times

Unfortunately the service times varied greatly and did not follow any specific trend, as was the case with the inter-arrival times. An explanation for this can perhaps be due to the many different factors which effect the length of a call in this particular environment. These include agent experience, type of error being faced by a customer, the agent and customers communication abilities and external factors such as the speed of the software tools used by agents.

Long term system stability

The probability that the system will be on average in a certain state (contain a certain number of customers) over a long term horizon can in some cases be determined using queuing theory, provided valid distributions or forecasting models are available for modelling of system components such as inter-arrival times and service times. If calls are lost (as is the case here), this probability that the system will change from its current state to some future state, is dependent on the number of customers in the queue. The modelling of the system state change could then be achieved using complex differential equations (Rao & Jaiswal 1969). However, due to the high loss rate leading to an unpredictable system state, as well as the unpredictability of service times due to the factors mentioned earlier, this approach was not investigated further during this study.

The current service level does not accomplish the desired 80:20 model. The arrival rate is significantly higher than the service rate, and nearly every customer is placed in the queue. The time that a customer is prepared to wait for service is unknown and determined by a large number of factors such as importance of the problem, cost of the call and time available to the customer to make the call (Kelton 2007).

However, there is a pivotal point where the arrival rate would be less than the service rate, at which point clients' calls would be answered as soon as or shortly after they enter the system.

Given that *s* agents are on duty, and each agent has an average service time of *t* minutes, to reach the desired pivotal point,

$$\text{arrival rate} \leq s \times t = \text{service rate}. \qquad (1)$$

This ensures that the system does not "snowball", since agents answer calls as they arrive.

Let the value ρ indicate some stability constant of the system, where

$$\rho = \frac{\text{arrival rate}}{\text{service rate}}. \qquad (2)$$

If $\rho \leq 1$, the system will remain stable and customer waiting time will be kept to a minimum. It is therefore in the interest of this study to determine a set of circumstances such that $\rho \leq 1$, in order for the helpline to achieve the required 80:20 efficiency. The upper bound of $\rho = 1$ can be considered the "snowball" bound and should be avoided. For the current system $\rho > 2$, an unacceptable state of affairs, and if nothing is done, the system will snowball indefinitely.

SERVICE LEVEL IMPROVEMENT

Three factors were identified during this study, which were considered influential in terms of service level improvement – the individual service rate of agents, the number of agents on duty and the arrival rate of customers. It was decided to concentrate on business hours only, since a service level improvement during business hours would directly affect the service level after hours.

Number of agents on duty

An average of 60 agents are currently on duty per daily shift. The arrival rate is 637 calls per hour. The service rate is on average 5.44 calls per hour per agent and the measured total service rate is 326 queries per hour. If the current service and arrival rate remain unchanged, from equation (1), the company would need to employ 118 agents in order to remain below the "snowball" bound.

Service Rate

A further influential factor in the general service level of the helpline is the service rate of individual agents. The intention, however, is not simply to demand a higher working pace from the agents, but to focus their efforts constructively and create a productive, comfortable work environment.

Currently each agent handles approximately 744 calls per month at an average rate of 11min 2seconds per call. If the average service time could be improved by 10%, a further 82 calls per month could be answered, and a further 5% would create capability for a further 131 calls per month.

An integrated sensitivity analysis is shown in Table 2, indicating how the number of agents on duty as well as the service rate can affect the number of calls answered, in an attempt to achieve $\rho \leq 1$. This is done working under the assumption that the arrival rate (637 per hour) will remain unchanged regardless of the improved service level.

Lightly shaded areas indicate a combination of the number of agents on duty and the average service rate which are sufficient for $\rho \leq 1$. The darker shaded areas indicate a combination of service rates and numbers of agents on duty, such that $\rho > 1$.

An improvement in service rate is clearly a more effective improvement measure than additional staff, however, it is clear that at least an additional 40 personnel are required in order to achieve required efficiency.

Arrival rate

In the previous analysis of service rate and the number of agents on duty, it was assumed that the arrival rate of customers would remain the same, since intuitively this variable is outside of the control of the helpline. However, one must bear in mind that the data presented thus far did not differentiate between number of customers calling in,

Arrival rate = 637	**Service level per hour**						
Agents on duty	**118**	**100**	**90**	**85**	**80**	**75**	**60**
Current	641	543	489	462	435	408	326
Service time +10%	713	604	543	513	483	453	362
Service time +15%	754	639	575	543	512	480	384

Table 2: Sensitivity analysis indicating how number of agents and service rate may affect the number of calls answered.

The effect of arrival rate on the helpline service level						
Agents on duty	**Improvement in arrival rate (%)**					
	0%	**10%**	**20%**	**30%**	**35%**	**40%**
	637	**573**	**510**	**446**	**414**	**382**
60	326,1	326,1	326,1	326,1	326,1	326,1
75	407,6	407,6	407,6	407,6	407,6	407,6
80	434,8	434,8	434,8	434,8	434,8	434,8
85	462,0	462,0	462,0	462,0	462,0	462,0
100	543,5	543,5	543,5	543,5	543,5	543,5

Table 3: Sensitivity analysis indicating how a reduction in arrival rate and an increase in the number of agents could effect the service level.

and number of calls. In other words, if a customer called in, but left the system before their call was answered, they would almost certainly call again, and the system would simply recognise them as a separate call. It can be argued, that should the service level improve to a point such that $\rho \leq 1$, that less customers would need to call more than once, and all the data currently in the system which is composed of calls from the same customers would be removed, reducing the arrival rate significantly.

The software used in the helpline records the number from which the customer is calling. Data regarding the number of clients who call more than once in a given hour could therefore be extracted from the data, in order to establish by what percentage the hourly arrival rate would drop, if a customer was served on their first or second call. An optimistic estimate is that the arrival rate could drop by more than 40%, if the 80:20 efficiency rate is achieved in terms of service rate and number of agents on duty.

Table 3 shows a sensitivity analysis of how a reduction in arrival rate, and an increase in agents could affect the service level.

As before, the lightly shaded area is where the helpline should strive to be, but it is clear that with the current number of agents, the arrival rate would need to reduce by an infeasible amount before the 80:20 efficiency could be achieved.

Integration of influential service level factors

All three influential service level factors can be addressed independently. As seen in the above sensitivity analyses, large improvements in each of the individual areas are required to achieve the desired result, whereas it is suspected that if a smaller improvement in both the number of agents on duty as well as the service rate was observed, the arrival rate would drop significantly and an acceptable customer service would be within reach of the helpline.

Number of agents required (basis 60 agents)						
Improvement in service rate	**Improvement in arrival rate (%)**					
	0%	**10%**	**20%**	**30%**	**35%**	**40%**
	637	**573**	**510**	**446**	**414**	**382**
Current	57,2	45,4	33,8	22,1	16,2	10,3
+10%	45,5	34,9	24,5	13,9	8,6	3,3
+15%	39,6	29,6	19,8	9,8	4,7	-0,3

Table 4: Number of extra agents required.

Table 4 indicates how many extra agents would be required to achieve the desired efficiency level if a basis level of 60 agents (current) is used to begin with.

SUGGESTED IMPROVEMENTS

The most important improvement required of the system is to ensure that the service rate is higher than the arrival rate ($\rho \leq 1$). In order to improve the service level of the helpline as a whole, the company need to take proactive steps to improve all three of the areas identified as factors which affect service level, namely service rate, arrival rate and number of agents on duty.

Agents

- The number of agents on duty must be adjusted in order to handle the workload
- The change over time of agents during shifts must be kept to a minimum
- Agents must answer consecutive calls as quickly as possible, a difficult proposition after a difficult client!
- Tools used by agents (software) must be of the highest quality and their workstations should be powerful enough to handle requests quickly
- Agents' working environment must be comfortable and their surroundings must be ergonomically designed for speed and high levels of extended concentration (comfortable chairs, desks etc)

Service rate

- An incentive program must be in place to encourage agents to deal with customers as quickly as possible.
- Agents should be rewarded for exemplary work and be presented with worthwhile incentives for high volumes of calls answered.
- Quality control must be enforced in order to ensure that the quality of the agents service is acceptable and not just their volume of customers handled
- Solutions to common problems faced by customers can be either mailed to them or placed under an FAQ section of a website, so that agents are not burdened with unnecessary problems which are easy to solve.
- Agents articulation must be excellent, and training is necessary to ensure agents communicate quickly and clearly

Arrival rate

- A better service rate will directly reduce the arrival rate, as discussed earlier.
- Solutions to common problems can be presented to customers whilst they are waiting in the queue
- If a large system failure has occurred, which affects many customers, it can be reported to customers waiting in a queue, hopefully causing them to leave the system and allow a reasonable timeframe for the problem to be resolved before returning
- A detailed customer guide could be compiled with solutions to many in depth problems, and made available to the client when they subscribe to the service. This will provide an offline help medium, hopefully consulted before the helpline.

IMPROVEMENT COSTS

The helpline can only achieve an acceptable service level if $\rho \leq 1$. However, the changes required to achieve this goal come at a price. Assuming the incentivisation program and other improvement suggestions which would lead to at least some improvement in service rate (and thus arrival rate) were implemented at a cost of no more than R500 000 and that the yearly salary of an agent is approximately R100 000, then the total improvement cost, would be

Number of extra agents X R100 000 + R500 000 (3)

Assuming the implementation cost will improve service rate by some percentage, the necessary extra agents which need to be hired can be established from Table 4 in order to establish the capital offset required to achieve an acceptable service

Cost of improvement (R1 000 000's) (basis of 60 agents)

Incentivisation implementation Cost **R 500 000**
Salary Cost **R 100 000**

Improvement in Service rate	**Improvement in arrival rate (%)**					
	0%	**10%**	**20%**	**30%**	**35%**	**40%**
Current	-R 6,30	-R 5,10	-R 3,90	-R 2,80	-R 2,20	-R 1,60
+10%	-R 5,10	-R 4,00	-R 3,00	-R 1,90	-R 1,40	-R 0,90
+15%	-R 4,50	-R 3,50	-R 2,50	-R 1,50	-R 1,00	-R 0,40

Table 5: Costs incurred in R1000000's, if the required number of extra agents (Table 4) were to be employed.

level shown in Table 5.

It is clear from this information that an attempt should be made to improve service rate as much as possible (probably leading to improved arrival rate), since if left as is, R6.3 million will need to be spent to achieve the required service level by hiring of new personnel alone.

CONCLUSION

The current service level of the helpline is unacceptable and drastic intervention is required in order to produce an acceptable customer service. This can only be achieved if service rate at least equals arrival rate, and therefore should be the primary focus of the helpline.

It was discovered that although the number of required agents for an acceptable service level could be quantified, the cost of hiring this number would be unnecessarily high when compared to the costs of implementing systems which could improve service rate. Improvement in service rate was found to directly influence arrival rate, the third influential factor identified in service level improvement, and an improvement in both service rate and arrival rate was found to minimise the number of extra agents required to achieve an acceptable service level.

The author's suggestion is that service rate of individual agents be improved as much as possible, and thereafter once an observation of what this improvement has made on arrival rate has been established, the necessary number of extra agents can be hired. This strategy would minimise the total cost of improving the helpline and bring it up to an acceptable standard.

[1] Kelton, WD, Sadowski, RP & Sturrock, DT 2007, '*Simulation with Arena'*, McGraw-Hill, New York.

[2] Rao, SS & Jaiswal NK 1969, 'On a Class of Queuing Problems and Discrete Transforms', *Operations Research*, vol. 17, no. 6, bl. 1062-1076.

ORSSA AWARDS NOMINATIONS

Tom Rozwadowski Medal

"The nominating committee for the Tom Rozwadowski medal invites submissions for consideration to be emailed to the Vice-President, Marthi Harmse, at marthi.harmse@sasol.com on or before Monday 21 April 2008. This medal is the premier award of the Operations Research Society of South Africa (ORSSA) and has been awarded on an almost annual basis since 1971. The medal is awarded for the best written contribution to Operations Research (OR) made by a member of the Society during the previous year.

Please refer to the ORSSA website (http://www.orssa.org.za/wiki/pmwiki.php?n=Awards.TomRozwadowskiMedal) for the rules applying for the award. In essence contributions of an OR nature published in any journal of international standing during the previous year, are eligible for consideration. All contributions in ORiON Volume 23 will be considered. Please note that only persons who were members of the Society, or who had already applied to become members of the Society when the contribution was made, are eligible for the award. Chapter chairpersons, in particular, are requested to ensure that all worthy material originating in their region is brought to the attention of the nominating committee."

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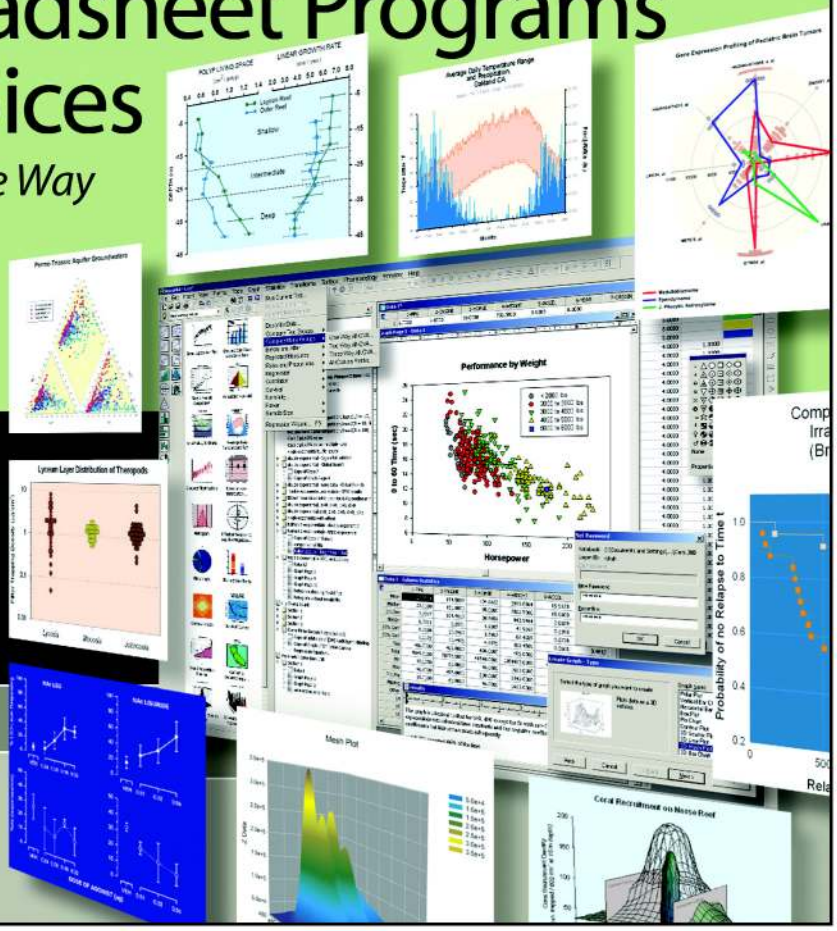

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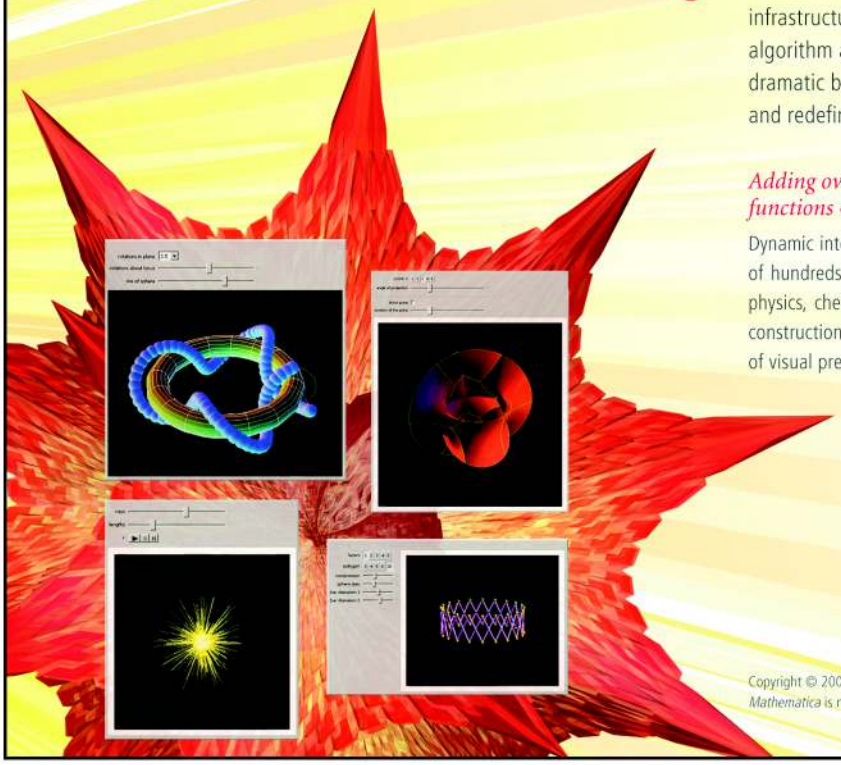

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