SAIIE nexxxxt

Alternative Realities, Real Alternatives

Programme Abstracts

30 September - 2 October 2019

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- Push & Pull systems
- Inventory management
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Welcome
to
The Annual Conference
of the
Southern African Institute for Industrial Engineering
Programme and Abstract Book
30 September – 2 October 2019
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Port Elizabeth, South Africa
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We can create a more sustainable, cleaner and safer world by making wiser energy choices.

Robert Alan Silverstein

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- Project Management
- Science, Technology and Innovation Policy
- Systems Engineering
- Technological Entrepreneurship and Innovation
- Technology Management

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Make today matter
Welcome Note

Welcome to SAIIEneXXXt, and welcome to the wild and beautiful Eastern Cape!

Reflecting on the welcome notes from the past five SAIIIE conferences, we noticed something interesting, that each year presents new challenges and opportunities. That each year we notice how uncertain and changing the world of the present is. And yet this change is inevitable and never-ending, the world was changing yesterday and last year and last century and is likely to continue changing rapidly for centuries into the future. So, for this conference, we challenge you to be present. To put aside the past and the future for just a few days and to allow yourself to experience each moment right here and right now. So, close those laptops, let those emails wait another few days, and embrace each presentation, each conversation, each breath of fresh air and bite of delicious food.

No matter how many days you are lucky enough to be spending with us during the SAIIEneXXXt conference, we hope that you will enjoy the exciting activities that we have planned. This year’s conference boasts a stimulating line up of keynote speakers and workshop presenters providing different perspectives on the world around us. We also draw in local industry with our automotive manufacturer panel discussion and our first industry tour day where we will visit some of the many energetic industries in Port Elizabeth. We are also looking forward to sharing our new format of presentations and posters with you which we expect will enable deeper engagement and allow enough time to catch up on what everyone is doing. To wind down at the end of each day look forward to some magic at the cocktail function, the sand between your toes and the wind in your hair at our beach games and the enchanting atmosphere of our gala dinner where we will present the conference awards.

We would like to take this opportunity to thank those that made this conference possible. A very big thank you to every one of our authors who has trusted us with their valuable work. Thank you to the reviewers who tirelessly provided feedback and to the organising team who brought everything together in the end. Thank you to those of you who are not presenting but took time out of your lives and chose to spend it with us. And thank you to all our sponsors and for the people of the Eastern Cape who have opened up their doors and their arms to welcome us to their province.

We trust that you will find it easy to lose yourself in the many new and thought-provoking ideas and breath-taking beauty that surrounds you. And once you return to your home when the conference is done, may you return renewed and inspired and ready to face the challenges ahead of you with Real Alternatives or Alternative Realities.

*When any real progress is made, we unlearn and learn anew what we thought we knew before.*

– Henry David Thoreau

Be present!

The SAIIEneXXXt organising committee

Dieter, Teresa, Lynette, Thereza, Corné and Stephan
WE MAKE THE WORLD GO ROUND

Industrial Engineers optimise systems by creatively designing solutions that integrate people, processes and technology.

The school is supported by 3 research focus groups:
- Engineering Analytics
- Operations and Supply Chain Excellence
- Industry 4.0 Initiatives

One of the top 10 scarce skills in South Africa

North-West University Engineering
(http://engineering.nwu.ac.za/industrial-engineering)
General Information

Venues
Aitutaki  plenary sessions, workshop, breakaway venue
Palawan  workshop, breakaway venue
Mamanuca  workshop, breakaway venue
Foyer  registration, exhibition, refreshments and lunch

Internet facilities
Wireless Internet is available at the conference centre and is free of charge.
Network  guest@sun

Social Programme
Monday 30 September 2019
18:00  Cocktail reception
Venue  PE St George’s Club (12 Bird Street, Central, Port Elizabeth)

Tuesday 1 October 2019
17:00  Fun on the beach

Wednesday 2 October 2019
18:00  Gala dinner
Venue  The Plantation (424A Sardinia Bay Road, Lovemore Park Elizabeth)
Transport  Buses will leave the Boardwalk Hotel at 17:15
Please note that the dinner is only for delegates who have booked and paid for the dinner in advance.

At the official functions (cocktail and conference dinner), wine, beers and soft drinks will be complimentary. All other drinks will be for the account of the delegates.

Presentations
Please load your presentations before the day you will present on Google Drive following this link:

https://www.formpl.us/form/422706149

Format: Paper ID_Presenting author surname.file extension (e.g. 1234_Fontein.pptx)

Presentations will take place in 45 minute sessions. Three presenters will be allocated to each of these sessions and will have 10 minutes to present their work. The audience is asked to pick a session and remain in the session for the full 45 minutes. After all three presentations the floor will be opened for a discussion with the panel of presenters.

Posters
Poster size: A3 (landscape orientation)
Please put your poster on the poster boards after you have registered – four posters on each side of the board. Only double sided Velcro supplied with the boards should be used to fix the posters. The posters have to be displayed for the duration of the conference.
Industry tours
Only for delegates who have booked for the industry tours on Thursday 3 October.

Departure: 08:00 from The Boardwalk Hotel
Time of arrival back at The Boardwalk Hotel: Approximately 16:00

You can bring your luggage with you on the bus if you must check out of your hotel that morning.

SAFETY GEAR REQUIREMENTS: Please wear safety shoes on the day to get access to the manufacturing areas of the industries to be visited.

CPD validation (SAIIE / CPD / 1 / 03-19)
SAIIEnenXXXt has been registered with ECSA for CPD (Continuing Professional Development) accreditation and the following points will be awarded:

Conference: 3 validation points (30 hours), 1 point per day
Industry tours: 1 validation point

Delegates who would like to get a CPD certificate should mark the relevant column on the attendance register and must also make sure that the QR code on their name tags get scanned at the registration desk once in the morning and once in the afternoon.

CPD points awarded will be based on the number of days delegates have been scanned. Please make sure the conference secretariat has your ECSA registration number or your ID number. SAIIE members can download their CPD certificate by navigating to www.saiie.co.za. Login with your username and password. Non-member to request their CPD certificate by e-mailing the request to conference@saiie.co.za.

Conference Proceedings
An electronic copy of the Conference proceedings is supplied to all delegates on a flash disk upon registration. Some papers have been selected for publication in a special edition of the South African Journal of Industrial Engineering and will not appear in the electronic version of the conference proceedings.

Delegate list
The delegate list with contact details of attendants is available on the flash disk in your delegate pack.

Name tags
Always wear your name tag to gain access to the conference venues and functions.

Presentation Rating Forms
You will find some Presentation Rating Forms in your delegate pack. Please use this to rate each of the lectures you attend and hand it in at the Registration desk after each day. The winners will be announced at the gala dinner on Wednesday night.
Photo competition
A prize will be awarded for the best photo taken during the week. To enter, upload your photos to the following Google Drive folder:

URL: https://formpl.us/form/581396132

File name Format: Photo name_Photographer.file extension

Conference secretariat
Please feel free to contact either the conference secretariat or members of the organising committee should you have any problems.

Thereza Botha       +27 (0)83 375 7373
Lynette Pieterse    +27 (0)83 652 3439

The conference secretariat will be available for any queries or assistance during conference hours.

We hope you enjoy SAIEmEeXXXT in the beautiful city of Port Elizabeth!
Acknowledgements

Thank you to the following sponsors and partners for their generous support of SAIIEneXXXt

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Stellenbosch University
James R. Carey is Distinguished Professor of Entomology at the University of California, Davis, and Senior Scholar in the Center for the Economics and Demography of Aging at UC Berkeley. Carey has taught workshops on information design and presentation strategies in science throughout the world including the European Doctoral School of Demography and the Consortium for Advanced Research Training in Africa.

Benji Coetzee
Calibre Capital
South Africa

Benji is an energetically intentional South African behavioral industrialist, polymath, mental-athlete and protagonist for a Forbes Top60 woman in technology (2018), a Top50 woman by Entrepreneur Magazine, trailblazer for change by CNBC Africa and impact challenger by Singularity University.

She is founder of "Emptytrips" and "Seedpitch Consulting", whilst serving as an executive board influencer to companies listed in South Africa, Saudi Arabia, Dubai, and America.

Prior to entrepreneurship, Benji spent a decade within professional services in South Africa, Germany, Switzerland, and Dubai across strategy consulting, investment banking and insurance with the Boston Consulting Group, Singular Group and HSBC.

Benji is also founder of AI-freight marketplace "Emptytrips"; uses algorithmic space matching and behavioral science to influence better operational decisions to reduce space, cost and carbon wastage on fleets. It boasts numerous awards including IITPSA Technology Excellence'18, Singularity U impact Venture'18, Frost & Sullivan Logistics Innovation'18.
Seedpitch has been recognised as one of the fastest growing strategic performance partners to executive leadership. Seedpitch Consulting enables progressive thinking paired with behavioural influence techniques for sustainable change.

Lastly, Benji is partner with investment company Calibre Capital to identify, invest in and grow businesses.

Benji holds a Bachelors (Finance) and Masters (Maritime) from Stellenbosch University and an LLM - Masters (Finance) from Goethe University in Germany.

Yanesh Naidoo
Sales and Design Director
Jendamark
South Africa

AS a 12-year-old boy, Yanesh Naidoo sold eggs and curry leaves to earn pocket money. Later, he moonlighted as a DJ to finance his B.Sc. Engineering studies in Mechatronics at the University of Cape Town. Today, as Jendamark’s director of sales and design, he has a much more interesting product to offer – the ever-evolving technology landscape of Industry 4.0.

Yanesh started his career as a project engineer for Volkswagen South Africa, where he was responsible for managing all aspects involved in sourcing equipment for VW’s production facilities.

It was this interest in automation that saw him join Jendamark as a business development engineer in 2004, serving various sectors including the automotive, pharmaceutical and packaging industries.

After the global economic crash of 2008, when many other industries turned inwards and diversified their interests locally, Jendamark took the bold step of seeking out new international markets and focusing solely on the automotive sector.

By then a company director driving this new vision, Yanesh was key in establishing new markets in Europe, Asia, Africa and North America. Under his guidance, Jendamark’s technology exports have grown to over 95% of the company’s annual turnover.

Today, he continues to identify opportunities for accelerated growth and aims to stay ahead of industry requirements by developing software solutions and using technologies such as augmented reality and virtual reality to create industry-leading assembly facilities.
Carel Snyman

Consultant
People l Energy l Mobility

Carel's involvement in energy started in 1988, when he joined the National Energy Council (NEC) – a governmental energy forum, funding related research and assisting government with the development of energy policy. He chaired various steering committees (Removing lead from petrol, optimising octane levels for petrol in South Africa, researching alternatives to petroleum, etc.) in collaboration with the automotive and oil industries. Most of his work focused on alternative transport energy and this led to the start of a programme to evaluate electric vehicle technologies and its application in South Africa.

When the NEC closed their doors in 1992 (due to changes in SA government), Carel continued his career at Eskom where he was responsible for and directed the Electric Transport Programme. Various electric vehicles were developed for demonstration purposes and put into real life operations. (Electric game viewing vehicle in the Kruger National Park, shuttle buses on Robben Island, Kyalami Business Park, etc.) A small electric utility vehicle developed locally with Nissan Sani was shown on the SA DTI stand in Paris, during April 2002. Eskom stopped doing work on electric vehicles in 2002 when the oil prices fell to $12 a barrel - removing the risk to the country.

After a short career in information technology, Carel established his own business and energy consulting company in August 2006. Main clients were the Automotive Industrial Development Corporation and SANERI/SANEDI. In 2013 SANEDI persuaded Carel to take up a career in SANEDI as General Manager of the Cleaner Mobility Programme - in order to work with national government to lay the foundation for cleaner mobility in South Africa. Carel worked at SANEDI from June 2013 to January 2018. It was at SANEDI, working with city officials, that it became clear that by only changing the modes of transport to use energy more efficiently, is not the final road to sustainable mobility in cities. The city and its mobility options for people and freight needed to be re-invented. This led to work on a proposal to the African Development Bank for the development of smart cities with sustainable mobility in sub Saharan Africa – an ongoing project.

Currently, with the vision for sustainable cities for Africa in mind, Carel is actively developing community, energy and mobility products and projects, doing consulting, mentoring, lecturing and coaching.
Workshops

Workshop 1
Becoming a PowerPoint Superhero

Prof James R Carey

Distinguished Professor
Department of Entomology
University of California
USA

James R. Carey is Distinguished Professor of Entomology at the University of California, Davis, and Senior Scholar in the Center for the Economics and Demography of Aging at UC Berkeley. Carey has taught workshops on information design and presentation strategies in science throughout the world including the European Doctoral School of Demography and the Consortium for Advanced Research Training in Africa.

Workshop Outline

Carey’s presentation will be divided into three parts:

(1) Information design—basics of typography, graphics, color and layout. Design in presentations is a requirement and not a cosmetic addition;
(2) Presentation strategies—PowerPoint capabilities are as underutilized as they are misused. Attendees will learn how to become sophisticated users of this presentation software, particularly with respect to the judicious use of animation, color palettes, content arrangement, and decluttering;
(3) Storytelling concepts—the use of storytelling concepts encourages presenters to consider the presentation as a whole with different acts, with a story arc, and sometimes with a touch of drama.

Workshop2
Introduction to Six Sigma

Dr Karl van der Merwe
Senior Lecturer
Department of Industrial Engineering, Operations
Management and Quality
Nelson Mandela University

Karl van der Merwe has been a practicing industrial engineer since 1989 who, after a fifteen-year stint in the automotive sector, moved to an academic environment to pursue a career in teaching, research and consulting. Karl holds a doctorate in operations management, which was granted by the NMMU, based on research completed in the field of Lean and Six Sigma operations. He is currently overseeing a number of continuous improvement research projects in collaboration with industry partners. Karl is also an enthusiastic (but not very talented) cyclist, currently residing in Port Elizabeth, South Africa.

Workshop Outline
This half-day workshop will introduce participants to the Six Sigma methodology, including its background and underlying logic. The majority of the time, however, will be allocated to a hands-on exercise that is used worldwide to teach the principles of Six Sigma. Participants will have the opportunity to define, measure, analyse, improve and control a process in small teams, using a purpose designed instrument.
Workshop 3
Software Robotics and Machine Learning

Dr Joke Bührmann
Senior Lecturer
Senior Lecturer Industrial Engineering
University of the Witwatersrand

Dr. Joke Bührmann is a senior lecturer in Industrial Engineering at the University of the Witwatersrand specialising in Operations Research and Machine Learning. She has industry experience in areas including business analytics, data and optimisation analysis, business intelligence and application development.

Jan-Rudolph Bührmann
Technical Lead: Automation
Diverse I.T. Connections

Mr. Jan-Rudolph Bührmann is technical lead in Intelligent Automation at Diverse I.T. Connections. He has vast experience in Java programming and application development at corporate industries including Standard Bank and Discovery.

Workshop Outline
The workshop will cover how and where machine learning fits into our current day-to-day working lives. We will give an overview and demonstrate how a person can use machine learning techniques in data analytics and forecasting. There will also be a demonstration on software robotics, where it fits in the machine learning landscape and how this can be used as part of process engineering to automate computer processes.
## Programme

### Monday 30 September 2019

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<th>Event</th>
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<tr>
<td>08:00</td>
<td>Registration</td>
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<tr>
<td>09:00</td>
<td><strong>Workshop 1</strong>&lt;br&gt;Venue: Aitutaki&lt;br&gt;Introduction: Freddy Tshikala</td>
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<tr>
<td>09:00</td>
<td><strong>Workshop 2</strong>&lt;br&gt;Venue: Palawan&lt;br&gt;Introduction: Jacques Fauré</td>
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<td>09:00</td>
<td><strong>Workshop 3</strong>&lt;br&gt;Venue: Mamanuca&lt;br&gt;Introduction: Dieter Hartmann</td>
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<td>Becoming a PowerPoint Superhero&lt;br&gt;James Carey</td>
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<td></td>
<td>Introduction to Six Sigma&lt;br&gt;Karl van der Merwe</td>
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<td>Software Robotics and Machine Learning&lt;br&gt;Joke Bührmann&lt;br&gt;Jan-Rudolph Bührmann</td>
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<td>10:30</td>
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<td>11:00</td>
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<tr>
<td>12:30</td>
<td>Lunch</td>
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<td>13:30</td>
<td>WELCOMING &amp; Chair: Dieter Hartmann, SAIIE President&lt;br&gt;Venue: Aitutaki</td>
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<td>13:50</td>
<td>KEYNOTE ADDRESS: Benji Coetzee&lt;br&gt;Dataism: A simpler perspective to pioneer</td>
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<td>Tea/Coffee</td>
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<tr>
<td>Session A1</td>
<td>Session A2</td>
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<tr>
<td><strong>Supply Chains - Lean, green and hi-tech</strong>&lt;br&gt;<strong>Venue</strong>: Aitutaki&lt;br&gt;<strong>Chair</strong>: Freddy Tshikala</td>
<td><strong>Simulation modelling and optimisation</strong>&lt;br&gt;<strong>Venue</strong>: Palawan&lt;br&gt;<strong>Chair</strong>: Corné Schutte</td>
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<td>4206 EVALUATING LEAN IMPLEMENTATION SUCCESS IN SMALL AND MEDIUM MANUFACTURING ENTERPRISES&lt;br&gt;Robin Mabunda</td>
<td>4193 MISSION-READY RESOURCE ALLOCATION AS A DYNAMIC PROBLEM&lt;br&gt;Bernard Leuvennink</td>
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<td>4209 A TECHNOLOGY BASED SUPPLY CHAIN MANAGEMENT [AN ENGINEERING TECHNOLOGIST APPROACH TO SCM DESIGN]&lt;br&gt;Ngaka Mosia</td>
<td>4231 FIBRE NETWORK PLANNING WITH RETRACTABLE CABLE TECHNOLOGIES&lt;br&gt;Ruan Luies</td>
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<td>4275 THE STATUS OF GREEN SUPPLY CHAIN INITIATIVES IN MANUFACTURING ENGINEERING SMES&lt;br&gt;Bernadette Sunjka</td>
<td>4245 META-MODELS OF MONTE CARLO SIMULATION MODELS&lt;br&gt;Paul Kruger</td>
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<tr>
<th>Session B1</th>
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<tr>
<td><strong>The future of supply chains</strong>&lt;br&gt;<strong>Venue</strong>: Aitutaki&lt;br&gt;<strong>Chair</strong>: Bernadette Sunjka</td>
<td><strong>Optimising transport</strong>&lt;br&gt;<strong>Venue</strong>: Palawan&lt;br&gt;<strong>Chair</strong>: Jacques Fauré</td>
<td><strong>Implementing Lean - The People factor</strong>&lt;br&gt;<strong>Venue</strong>: Mamanuca&lt;br&gt;<strong>Chair</strong>: Grace Kanakana-Katumba</td>
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<tr>
<td>4269 RISK MANAGEMENT IN SUPPLY CHAIN INFORMATION FLOW: A STUDY OF SELECTED FOOD PROCESSING COMPANIES IN SOUTH AFRICA&lt;br&gt;Bruno Emwanu</td>
<td>4202 SIMULATING VARIABLES THAT CAUSE DISTURBANCES IN ARTERIAL ROADS&lt;br&gt;Zanele Mpanza</td>
<td>4207 AN INVESTIGATION INTO KEY ENABLING FACTORS FOR THE SUCCESSFUL IMPLEMENTATION OF KANBAN SYSTEMS IN SOUTH AFRICA: A CASE STUDY&lt;br&gt;Kemlall Ramdass</td>
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<td>4302 SUPPLY CHAIN RESEARCH IN RETAIL&lt;br&gt;Louis Stemmet</td>
<td>4263 USING EXCEL SOLVER IN THE OPTIMIZATION OF PREPOSITIONED DISASTER RELIEF SUPPLY CHAIN IN A HUMANITARIAN OPERATION&lt;br&gt;Mendon Dewa</td>
<td>4229 APPLICATION OF LEAN PRINCIPLES IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY&lt;br&gt;Isabellah Maradzano</td>
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<td>4306 EVALUATING THE IMPACT OF E-COMMERCE FREIGHT MOVEMENTS IN SOUTH AFRICAN CITIES&lt;br&gt;Elizna Cilliers</td>
<td>4240 ASSESSMENT OF HIGH SPEED TRAINS CATEenary WIRE FOR MAINTENANCE DECISION MAKING&lt;br&gt;Mpho Lelala-Mnguni</td>
<td>4290 TOWARDS DESIGNING AN ARTEFACT EVALUATION STRATEGY FOR HUMAN FACTORS ENGINEERING: A LEAN IMPLEMENTATION MODEL CASE STUDY&lt;br&gt;Rojanette Coetzee</td>
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**COCKTAIL RECEPTION**<br>St Georges Club
### Registration

**WELCOMING & CHAIR:** Jacques Fauré  
**Venue:** Aitutaki  
**KEYNOTE ADDRESS:** Carel Snyman  
*A Better way to Move*

### Tea/Coffee

### POSTER SESSION

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<thead>
<tr>
<th>Session C1</th>
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<tr>
<td><strong>Product life cycles and value chains</strong></td>
<td><strong>Environmental alternatives</strong></td>
<td><strong>Decision making</strong></td>
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<td><strong>Venue:</strong> Mamanuca</td>
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<tr>
<td><strong>Chair:</strong> Ann Lourens</td>
<td><strong>Chair:</strong> Whisper Maisiri</td>
<td><strong>Chair:</strong> Teresa Hattingh</td>
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<tr>
<td>4141</td>
<td>A SYSTEMATIC LITERATURE REVIEW ON THE TITANIUM METAL PRODUCT VALUE CHAIN</td>
<td>Nicolene Roux</td>
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<tr>
<td>4145</td>
<td>A GENERAL APPROACH TO DEVELOP AND ASSESS MODELS ESTIMATING COAL ENERGY CONTENT</td>
<td>Chantelle van Aarde</td>
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<tr>
<td>4142</td>
<td>THE USE OF ANALYTICAL HIERARCHY PROCESS (AHP) FOR WELDING PROCESS SELECTION DURING RAIL CAR MANUFACTURING</td>
<td>Ilesanmi Daniyan</td>
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<tr>
<td>4228</td>
<td>A FRAMEWORK FOR SUCCESSFUL NEW PRODUCT DEVELOPMENT</td>
<td>Lia Pienaar</td>
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<tr>
<td>4262</td>
<td>EVALUATION OF THE EVAPORATOR SYSTEM OF AN ATMOSPHERIC WATER GENERATOR DESIGNED FOR RURAL KWAZULU-NATAL</td>
<td>Daramy Kallon</td>
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<td>4288</td>
<td>A STRATEGIC FRAMEWORK FOR START-UP MEDICAL DEVICE MANUFACTURERS IN SOUTH AFRICA</td>
<td>Ishan Maharaj</td>
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<td>4299</td>
<td>FLOW PROPERTIES UPON TREATMENT OF ACID MINE DRAINAGE USING PERVIOUS CONCRETE</td>
<td>Daramy Kallon</td>
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<td>4299</td>
<td>USING MULTI CRITERIA DECISION MAKING FOR HUMANITARIAN PLANNING DURING A LAST MILES RELIEF SUPPLY IN SADC</td>
<td>Mendon Dew</td>
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*Note: Some poster titles and authors are placeholders as the actual content is not provided in the image.*

*Date: Tuesday 1 October 2019*
<table>
<thead>
<tr>
<th>Session D1</th>
<th>Session D2</th>
<th>Session D3</th>
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</table>
| **Industry 4.0 Readiness**  
Venue: Aitutaki  
Chair: Henk Harmse | **Managing people**  
Venue: Palawan  
Chair: Rojanette Coetzee | **Data management and reporting**  
Venue: Mamanuca  
Chair: Anthon Botha |
| INDUSTRY 4.0 READINESS ASSESSMENT FOR SOUTH AFRICAN INDUSTRIES  
Whisper Maisiri | FRONT-LINE SUPERVISOR EFFECTIVENESS ASSESSMENT ON AN ENGINEERING SHOP-FOUR  
Phlani Zimcu | IMPROVING DATA MANAGEMENT FOR ENVIRONMENTAL REPORTING IN GOLD MINES  
Maryke Janse van Rensburg |
| TOWARDS INDUSTRY 4.0: A ROADMAP FOR THE SOUTH AFRICAN HEAVY INDUSTRY SECTOR  
Jaco Prinsloo | BALANCING LEADERSHIP STYLES BASED ON PROJECT TYPE AND LIFE CYCLE PHASES: A MODEL  
Suzaan Pretorius | A FRAMEWORK FOR STANDARDISED INDUSTRIAL PROCESS DATA REPORT STRUCTURING  
Stéphan Taljaard |
| AN ANALYSIS ON THE EXTENT TO WHICH INDUSTRY 4.0 HAS BEEN CONSIDERED WITHIN SUSTAINABILITY OR SOCIOTECHNICAL TRANSITIONS  
Martha Asiimwe | A SKILLS MEASUREMENT MODEL FOR THE SOUTH AFRICAN ENERGY SECTOR: APPLYING THE ANALYTIC HIERARCHY PROCESS TO THE SA ELECTRIC POWER INDUSTRY  
Bernadette Sunjka | ALTERNATIVE DATA STRUCTURES FOR IMPROVED ENERGY REPORTING AND BUDGETING ON GOLD MINING GROUP OPERATIONS  
Pieter Peach |

### Lunch

<table>
<thead>
<tr>
<th>Session E1</th>
<th>Session E2</th>
<th>Session E3</th>
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</table>
| **Managing assets**  
Venue: Aitutaki  
Chair: Bernard Parschau | **People - Change, Fear and Queues**  
Venue: Palawan  
Chair: Teresa Hattingh | **Opportunities in the workplace**  
Venue: Mamanuca  
Chair: Mendon Dewa |
| DEVELOPMENT AND PERFORMANCE EVALUATION OF A HUMIDITY MEASUREMENT BENCH  
Ilesanmi Daniyan | THE IMPACT OF CHANGE MANAGEMENT STRATEGIES IN ENHANCING ORGANIZATIONAL PERFORMANCE: THE CASE OF NPWP PUBLIC ORGANIZATION  
Kemlall Ramdass | USE OF SCIENTIFIC ERGONOMIC PROGRAMS TO IMPROVE ORGANISATIONAL PERFORMANCE  
Rishna Roopnarain |
| BUILDING BLOCKS FOR CONTINUOUS IMPROVEMENT: RESULTS OF THE ENERGY MANAGEMENT PILOT PROJECT IN SOUTH AFRICAN FOUNDRIES  
Dalmari McQueen | FEAR, THE GREAT ENEMY  
Sabrina Chatur | IMPACT OF A WORKPLACE ORIENTATION WORKSHOP ON ENGINEERING STUDENTS’ WORKPLACE READINESS  
Ann Lourens  
Mieshkah Dolley-Ryneveld |
| INDUSTRY 4.0 ROLL-OUT STRATEGY FOR DYNAMIC MINE HEAT LOAD MANAGEMENT  
Diaan Nell | PROACTIVE SERVER ALLOCATIONS IN SINGLE QUEUING SYSTEMS  
Joke Bührmann | DECODING LINE BALANCING AS A LEAN STRATEGY IN ASSEMBLY LINE BALANCING: A CLOTHING MANUFACTURING PERSPECTIVE  
Kemlall Ramdass |
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<tr>
<td>14:15</td>
<td><strong>Service industries in the spotlight</strong></td>
<td><strong>Educating engineers</strong></td>
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<td>15:00</td>
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<td><strong>Chair:</strong> Ngaka Mosia</td>
<td><strong>Chair:</strong> Philani Zincume</td>
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<td>4171</td>
<td>INVESTIGATING THE ROOT CAUSES OF LONG LEAD TIMES IN THE AUTOMOTIVE AFTERSALES INDUSTRY BY MEAN OF THE LEAN PHILOSOPHY: A SOUTH AFRICAN CASE STUDY Mia Mangaroo-Pillay</td>
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<td>4246</td>
<td>A PATIENT-CENTRIC SIX-SIGMA DECISION SUPPORT SYSTEM FRAMEWORK FOR CONTINUOUS QUALITY IMPROVEMENT IN CLINICS Sanelisiwe Hlongwane</td>
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<td>4268</td>
<td>IMPROVING CUSTOMER SERVICE THROUGH FMCG MANUFACTURING FIRMS IN GAUTENG: A SERVITIZATION APPROACH Bruno Emwanu</td>
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<td>15:00</td>
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<td><strong>Chair:</strong> Dieter Hartmann</td>
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| 08:30 | Welcoming & Chair: Corné Schutte  
Venue: Aitutaki  
KEYNOTE ADDRESS: James Carey  
The evolutionary demography of humans as an industrial engineering problem |
| 09:45 | Tea/Coffee                                                            |
| 10:15 | POSTER SESSION                                                        |
| 11:00 | Session G1  
Six Sigma and quality  
Venue: Aitutaki  
Chair: Kem Ramdass |
| 11:15 | Session G2  
Influencing policy  
Venue: Palawan  
Chair: Brian Munsamy |
| 11:30 | Session G3  
Optimising maintenance  
Venue: Mamanuca  
Chair: Daramy Kallon |

### Session G1: Six Sigma and Quality
- **Presentation**: An Application of the Control Chart and Fishbone Diagram for Minimizing Defects in Sand Casting Process  
  **Presenter**: Cindy Sithole  
- **Abstract**:  
  4183

### Session G2: Influencing Policy
- **Presentation**: Adapting Accounting Best Practices for Use in Energy-Related Reporting  
  **Presenter**: Janine Booysen  
- **Abstract**:  
  4161

### Session G3: Optimising Maintenance
- **Presentation**: A Control Processes to Sustain Electricity Cost Savings on a Mine Water Reticulation System in Spite of Critical Component Failures  
  **Presenter**: Bertie Pascoe  
- **Abstract**:  
  4185

### Poster Presentations

- **Poster 4183**: Evaluating the Use of Six Sigma in the Implementation of Improvement Projects in a Freight Rail Company  
  **Presenter**: Amukelani Baloyi

- **Poster 4161**: Industrial Engineering Techniques and Service Delivery in Municipalities  
  **Presenter**: Rita Steenkamp

- **Poster 4185**: A Control Processes to Sustain Electricity Cost Savings on a Mine Water Reticulation System in Spite of Critical Component Failures  
  **Presenter**: Bertie Pascoe

- **Poster 4198**: South African Economy and the Use of DMAIC Six-Sigma in the Conflicts Resolution: Case Study from Leading Packaging Company in South Africa  
  **Presenter**: Mendon Dewa

- **Poster 4221**: Systematic Literature Review of Sustainable Urban Planning Challenges Associated with Developing Countries  
  **Presenter**: Andre Jooste

- **Poster 4239**: Integration of Catenary Tracer to Assess Train Catenary of High Speed Trains  
  **Presenter**: Mpho Lelala-Mnguni

- **Poster 4267**: Evaluating the Use of Six Sigma in the Implementation of Improvement Projects in a Freight Rail Company  
  **Presenter**: Amukelani Baloyi

- **Poster 4340**: Systematic Literature Review of Sustainable Urban Planning Challenges Associated with Developing Countries  
  **Presenter**: Andre Jooste

- **Poster 4252**: Comparison and Correlation of Nano-Indentation Hardness to Microhardness in Alloys  
  **Presenter**: Steadyman Chukimba
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<td>Speeding up services</td>
<td>Saving energy</td>
<td>Industry 4.0 Opportunities</td>
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<td>12:30</td>
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<td>Chair: Bruno Emwanu</td>
<td>Chair: Dieter Hartmann</td>
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<td>4173</td>
<td>REDUCING PARCEL PROCESSING BY MEANS OF THE LEAN METHODOLOGY</td>
<td>4167 STRUCTURING UNCERTAINTY MANAGEMENT FOR ENERGY SAVINGS CALCULATIONS</td>
<td>4218 INNOVATING FOR MARKET ADOPTION IN THE FOURTH INDUSTRIAL REVOLUTION</td>
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<td>Waldo Hamer</td>
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<td>4321</td>
<td>INVESTIGATING HUMAN BEHAVIOUR IN QUEUES</td>
<td>4307 DESIGN AND MANUFACTURE OF SOLAR POWERED GRASS TRIMMER</td>
<td>4323 THE EVOLUTION OF BUSINESS MODELS FROM SUPPLY CHAIN TO AGILE DEMAND NETWORKS THROUGH ADDITIVE MANUFACTURING</td>
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<td>Joke Bührmann</td>
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<td>Motibeli Pita</td>
<td>Henk Harmse</td>
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<td>4314 EFFECT OF DISCHARGE DIAMETER ON CENTRIFUGAL PUMP PERFORMANCE</td>
<td>4375 AN ASSOCIATION FOR PERFORMANT BIG DATA VENTURES BY INDUSTRIAL ENGINEERS</td>
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<td>Motsi Matlakala</td>
<td>Ninett Hesse</td>
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<td>12:30</td>
<td>Data meets knowledge</td>
<td>Making machines work for us</td>
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<td>13:30 –</td>
<td>Venue: Aitutaki</td>
<td>Venue: Palawan</td>
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<td>14:10</td>
<td>Chair: Waldo Viljoen</td>
<td>Chair: Kemlall Ramdass</td>
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<td>4168</td>
<td>FINDING THE FOUR QUALITIES TOWARDS INTELLIGENT INDUSTRIAL REPORTING</td>
<td>4305 SELECTION OF A COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM FOR MECHANICAL AND INDUSTRIAL LAB EQUIPMENT OF UNISA</td>
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<td>Lee-Ann Botes</td>
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<td>Mathibeli Pita</td>
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<td>4186</td>
<td>SOCIAL MEDIA: A KNOWLEDGE SHARING TOOL IN ORGANISATIONS</td>
<td>4174 DEVELOPMENT OF AN INTEGRATED PROJECT LIFE CYCLE MODEL ON GOLD MINING COMPRESSED AIR SYSTEMS</td>
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<td>Corro van Waveren</td>
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<td>Franco Jansen van Rensburg</td>
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<td>4254</td>
<td>THE IMPACT OF DESIGN, MANUFACTURING AND END OF LIFE LOGISTICS OF CONSUMER PRODUCTS</td>
<td>4282 INFLUENCE OF IMPELLER BLADE COUNT ON THE PERFORMANCE CENTRIFUGAL PUMPS</td>
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<td>Steadyman Chikumba</td>
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Lunch

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### Session K1

**Intelligent decision making**
- **Venue:** Aitutaki
- **Chair:** Joke Bührmann

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<tr>
<td>4175</td>
<td>A FRAMEWORK FOR A DECISION SUPPORT TOOL IN AN AGILE AGRICULTURAL ENVIRONMENT</td>
<td>Jolene Wium</td>
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<td>4217</td>
<td>DEVELOPMENT OF A FRAMEWORK FOR APPLICATION IN THE SELECTION OF AN APPROPRIATE PRODUCTIVITY IMPROVEMENT TECHNIQUE</td>
<td>Ngaka Mosia</td>
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<td>4363</td>
<td>QUALITY RESEARCH MANAGEMENT IMPROVES DESIGN RESEARCH EFFECTIVENESS</td>
<td>Johann Holm</td>
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### Session K2

**Engineering healthy solutions**
- **Venue:** Palawan
- **Chair:** Hanneke Meijer

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<tr>
<td>4184</td>
<td>A DECISION MODEL TO SUPPORT THEATRE ALLOCATION FOR NON-ELECTIVE PATIENTS IN A PRIVATE HOSPITAL</td>
<td>Chantelle du Plessis</td>
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<tr>
<td>4195</td>
<td>HEALTH CARE DATA MANAGEMENT IN DEVELOPING COUNTRIES: A SYSTEMATIC REVIEW</td>
<td>Laubscher van der Merwe</td>
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<td>4247</td>
<td>MEDICINES STOCK VISIBILITY SUPPORT TOOL USING DEMAND-DRIVEN SUPPLY CHAIN MANAGEMENT PRINCIPLES</td>
<td>Sanelisiwe Hlongwane</td>
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### Tea

- **Chair:** Dieter Hartmann
- **Venue:** Aitutaki
- **KEYNOTE ADDRESS:** Yanesh Naidoo  
  *4IR, The African Way*

### Buses depart from Boardwalk hotel to The Plantation

**GALA DINNER**

The Plantation

### Thursday 3 October 2019

**INDUSTRY VISITS**

- **Departure and drop off from the Boardwalk Conference Centre**
KEYNOTE PAPER 1
DATAISM: A SIMPLER PERSPECTIVE TO PIONEER
Benji Coetzee

Overview
- Benji will introduce the concept of Dataism as a mindset orientation toward ethical, frugal, sustainable and commercially viable data innovation.
- She will summarise the success factors to capitalise on the potential of data, paired with the behavioral science insights to change and manage inherent human fears of inferiority often failing innovation projects.
- Her views are inspired by her entrepreneurial journey founding an award winning AI-enabled digital freight exchange platform named Emptytrips.

Extract
- Dataism declares that the universe consists of data flows, and the value of any phenomenon or entity is determined by its contribution to data processing, and as such the freedom of data and acceptance of processing methods (AI) will lead to our next evolution.
- To be productive and remain competitive, many have supercharged their data processing capabilities, albeit in closed networks, reducing much demand on our own personal capacities and the ability for systemic scaled insight-driven efficiency.
- Our cognitive functions are increasingly being outsourced to computational algorithms, simultaneously enhancing our decision-making capabilities and manipulating our behavior.
- As our views on data shift from empiricism to ideology, from datafication to dataism, it is easy to get caught in the fervor.
- Countless articles call for transparency, accountability, and privacy in the roll out of algorithmic practices.
- For one, the conventional data dogma has warped and distorted the concept of the algorithm into some kind of agential, all-knowing, impossible-to-comprehend being. This misconception suggests that an algorithm possesses authoritative power in itself, when in reality any influence the algorithm may project is the result of human design and legitimization.
- In other words, as the role of algorithms evolves to a semi-mythical (perhaps deified) status from Silicon Valley to Wall Street, it is often forgotten that algorithms are a product of human effort, and subject to human control.
- Data therefore is our currency, how we bet will determine the win.

Tags
Data science, dataism, big data, behavioral science, entrepreneurship, innovation,
KEYNOTE PAPER 3
THE EVOLUTIONARY DEMOGRAPHY OF HUMANS AS AN INDUSTRIAL ENGINEERING PROBLEM
James Carey

I argue that the great ape nest is the ancestral home of hominids and had the potential to serve as an evolutionary wellspring of architectural, technological and social innovation in human evolution. This idea is based on three concepts. The first is the fact that all four species of great apes build and use nests. Thus parsimony suggests that their common ancestor and, therefore, the ancestor of all hominids, was itself behaving similarly. Second, as E. O. Wilson notes in his book “The Social Conquest of Earth”, every animal known that evolved eusociality started with a protected nest from which forays could be made to collect food. This was important because members were forced to come together, cooperate and share. Third, evolutionary iterations of the nest likely occurred throughout human evolution starting from the great ape sleeping platform and moving through various stages of sophistication and re-use. The progressive iterations of this set of behaviors with the nest (hut; home) as both a sanctuary and a shelter, and nest building as an ever-evolving material skill may have played foundational roles in the evolution of family, developmental stages, pair bonding, clandestine sex, bi-parental care, tool use, and extended longevity.

KEYNOTE PAPER 4
4IR, THE AFRICAN WAY
Yanesh Naidoo

Jendamark Automation stays ahead of automotive industry requirements by looking beyond the horizon and designing tomorrow’s production facilities today.

For the past 10 years, Jendamark has focused on designing and manufacturing world class assembly facilities that include engine, axle, differential and catalytic assembly lines.

With global OEMs responding to the rapid changes triggered by the Fourth Industrial Revolution (4IR), Jendamark’s technology-driven solutions are already helping to improve manufacturing efficiencies for customers worldwide.

Having successfully delivered a number of 4IR projects for global customers, Jendamark will share their experiences on this uncharted journey towards 4IR assembly technology.

Jendamark’s head of sales, design and digital strategy, Yanesh Naidoo, will also outline the opportunities that exist for South African businesses involved in assembly and automation who are ready to embrace new markets and technologies.
SESSION A1
Supply Chains - Lean, green and hi-tech

4206 EVALUATING LEAN IMPLEMENTATION SUCCESS IN SMALL AND MEDIUM MANUFACTURING ENTERPRISES
R. Mabunda and G. Muyengwa
This study investigates lean manufacturing among South African small, medium and micro (SMMEs) manufacturing enterprises based in the Gauteng Province. Lean is widely regarded as a proven productivity improvement methodology; yet, its impact on South African SMMEs remains relatively unknown. The study used a mixed method approach. Survey data was analysed using statistical methods from 32 responses received from SMMEs in various manufacturing sectors. Interviews were conducted with management and workshop employees. The results revealed that most SMMEs experienced short-term successes that did not exceed three years, implying that they failed to sustain the gains of lean manufacturing. Factors found to have a positive impact on the success and sustainability of Lean implementations were change management, adequate budget, resources with appropriate skills, senior leadership commitment, and adherence to an implementation plan. These results contribute to the lean implementation theory and can be used as a guide by lean practitioners.

Robin Mabunda is the General Manager of Continuous Improvement, Quality Assurance and Process Control at Hulamin. Hulamin is a South African company based in Pietermaritzburg that specialises in rolled aluminium products for precision and high technology applications. Prior to Hulamin, Robin spent 14 years as a Continuous Improvement Consultant working with multiple blue chip companies. Today, his main focus areas are:
• Advanced process control;
• Machine learning;
• Digital transformation;
• Lean;
• Six Sigma;
• Leadership; and
• Strategy
This he does through his current Hulamin GM role.

4209 A TECHNOLOGY BASED SUPPLY CHAIN MANAGEMENT
[AN ENGINEERING TECHNOLOGIST APPROACH TO SCM DESIGN]
N. Mosia
The evolution of purchasing resulted into the concept of Supply Chain management. Supply chain management links all the supply activities and organizations in an integrated two-way communication system. The increase in global interconnectedness and inter-dependency, demands a dynamic technological innovation process for Supply Chain Management. Technology brings a new evolution that requires a different type of analysis and a management process. The new paradigm is technology driven and integrates supply chain management activities. The paradigm comprise of the original two-way communication between the original three tenants of a supply chain (Suppliers, manufacturing and Customers). The advent of technology brings with additions to the original Supply Chain Management components, these additional components include the external environment (PESTE) impact, big data, Internet of Things (IoT) and technology enhanced manufacturing. This qualitative research paper will present a new model of Supply Chain Management that will highlight the impact of technology on supply chain.

Ngaka Mosia is a Junior Lecturer in the department of Mechanical and Industrial Engineering, in the school of Engineering and a College of Science, Engineering and Technology at the University of South Africa (Unisa), in Gauteng, South Africa. He holds a BSc (Hons) in Applied Science from the University of Pretoria (UP), a BTech in Industrial Engineering from University of Johannesburg (UJ) and post graduate certificate in Distance education from the University of Maryland University College (UMUC). He holds the following awards, honors and academic distinctions:
**Special Guest (IEOM Conference), Outstanding Teaching Excellence Award, Excellence in Innovation Tuition (Unisa).** He has a research output of 3.5 in the past five years. His research interests include technology mediated teaching and learning and Productivity improvement through mechanization, Humanization for productivity improvement. He has been part of Unisa’s academic staff since 2013. He is a member of SAIE & PICTMET and Nadeosa & DEASA. As part of community service, he is involved in a Lean Healthcare project within a local healthcare facility and he is part of a Robotics outreach projects to local schools. His interests include Water sport, Chess and Robotics and designing miniature structures.

**4275 THE STATUS OF GREEN SUPPLY CHAIN INITIATIVES IN MANUFACTURING ENGINEERING SMES**

S. Malawana and B. P. Sunjka

Incorporating environmental thinking into the supply chain is a huge focus for businesses, governments and researchers alike because of declining natural resources and climate change issues. Regulatory and customer pressures are also contributing to this need for change. Businesses are transforming from traditional supply chain to circular economy. This research examined green supply chain (GSC) initiatives in Small and Medium Enterprises (SMEs) in the manufacturing sector. This examination is important because manufacturing and production are most commonly perceived as enemies to environmental protection. The aim was to understand what GSC initiatives are implemented (if any), awareness and barriers faced by manufacturing SMEs in the Gauteng area. A qualitative research methodology, using semi-structured interviews, was conducted with managers of SMEs. Findings revealed that the majority of the manufacturing SMEs are engaged in waste management, but that there are shortcomings in awareness of GSC concepts. Both regulatory and financial benefits were key drivers, while cost was the major barrier identified.

Bernadette Sunjka is the Head of the Industrial Engineering Stream and a Senior Lecturer in Industrial Engineering at Wits University. She has completed a PhD in Supply Chain Risk Management in South African Manufacturing SMEs. Her other research interests include Risk and Project Management.

**Session A2**

**Simulation modelling and optimisation**

**4193 MISSION-READY RESOURCE ALLOCATION AS A DYNAMIC PROBLEM**

B. Leuvennink and J. Bekker

The mission-ready resource allocation (MRRA) problem is well known and well defined in Operations Research. Resources are available and can be used to complete missions, while each resource has an associated lifting cost, and the aim is to minimise the total lifting cost to complete all missions. From a literature study in this domain, a gap was found that allows for further research. It was found that the MRRA problem has been formulated and solved as a static problem, however, real life problems are often dynamic and stochastic, i.e. several missions must be completed over a time period, while resource availability varies from mission to mission. In this study, we consider long-term resource allocation so that the overall cost is minimised, and not only for one mission. Also, after a mission is executed, some resources become unavailable for some time – the resources and the consequent unavailable times are not known to the decision-maker. Simulation and meta-heuristics are combined with the knowledge of the static MRRA problem to solve the dynamic, stochastic version of the MRRA problem.

Bernard is a Masters student at the University of Stellenbosch.

**4231 FIBRE NETWORK PLANNING WITH RETRACTABLE CABLE TECHNOLOGIES**

R. Luies and S. E. Terblanche

The passive optical network (PON) planning problem involves the computation of facility locations, such as splitters and central offices, and the placement of optical fibres in order to service demand points (optical network units). The objective of the PON planning problem is to minimise overall deployment cost. Traditional PON planning models assume the flexibility of single fibre configuration without having to take into account deployment-specific constraints. In this paper, a PON network planning model is proposed which specifically incorporates the use of retractable cable technologies for fibre deployment. The computational results presented
in this paper demonstrate the restrictive effect that retractable cable technologies may have on PON network configurations as well as the expected cost implications. Furthermore, initial results also suggest that a significant increase in computing times may be expected when computing solutions for PON planning problems that incorporate retractable cable technologies.

Ruan is an Industrial engineering PhD student at the NWU, his interests include mixed-integer linear programming.

4245

META-MODELS OF SIMULATION MODELS
P. Kruger

Simulation is used extensively for the modelling of large, complex, dynamic and stochastic systems, but tend to depend heavily on computer execution time. The severity of this problem has been lessened by the increasing execution speed of available computer hardware. However, the development of powerful and easy to use simulation languages has resulted in the increasing development of large and complex simulation models. Furthermore, real time applications of simulation models, requiring a quick response, are becoming more common. The inclusion of a simulation model as part of a bigger model might require numerous replications of the simulation model. This is, for example, true in the case of an optimization model using a simulation model in conjunction with a search algorithm. These kinds of models might still require extensive execution times and an applicable simulation meta-model might be useful. This paper will discuss and illustrate the development of meta-models of simulation models using techniques such as multi-variable regression and neural networks.

Paul Kruger is a retired professor of Industrial Engineering. At present he is a professor emeritus from the University of Pretoria and a professor extraordinaire from the University of Stellenbosch. He spends most of his time looking after his grandchildren and his collection of succulents while trying to survive in the information age.

Session A3
Building capacity

4154

AN INVESTIGATION ON INDUSTRY 4.0 SKILLS REQUIREMENTS
W. Maisiri, H. Darwish and L. van Dyk

The Industry 4.0 wave is built on technological advancement that is bringing about significant change. The impact of Industry 4.0 is being felt across all industries, including the education sector. During the 2019 state of the nation address, the president of South Africa pointed out that the government was seeking to respond to the change in skills requirements. In this paper a systematic literature review will be performed to investigate Industry 4.0 skills requirements in the engineering profession and the role of capability development in meeting industry 4.0 requirements. An exploration of the impact of Industry 4.0 on technical institutions as opposed to academic institutions will also be discussed. This paper incorporates this exploratory investigation into detailed research on developing a skills development framework that seeks to bridge the gap between Industry 4.0 skills requirements and development in South Africa.

Mr Whisper Maisiri is a Mechanical/Industrial Engineer and holds M Eng in Mechanical Engineering (North-West University, South Africa) and B.Eng. (Hon) degree in Industrial and Manufacturing Engineering (National University of Science and Technology, Zimbabwe. He possesses Certified Energy Manager International (CEMI) certification and post qualification experience in energy efficiency projects and industrial process performance optimisation. Currently he is pursuing a Doctor of Philosophy in Industrial Engineering with (North-West University, South Africa) under the supervision of Prof. Liezl van Dyk. His research focus is on Fourth Industrial Revolution and Industry 4.0 skills development in South Africa.
THE RELEVANCE OF TRADITIONAL INDUSTRIAL ENGINEERING DATA COLLECTION TOOLS & METHODS IN THE MODERN TECHNOLOGICAL AGE: A SURVEY ON THE PERCEPTION OF INDUSTRIAL ENGINEERS

B. Jughoo

Introduction
The effect of a fast-paced technological inclined world is that industry is constantly advancing. This wave leads to some trends such as the increase in environmentally friendly solutions and development of a paperless society. Industrial engineering is focused on continuous improvement, optimisation and cost saving. There may be new technologically aided tools available for use however due to the fast pace nature of industrial engineering the individuals may not have the time to source these software's and experiment with it.

Aim of study
Hence, the study aims to investigate the perceptions of IEs regarding traditional methods of industrial engineering versus new technologically advanced software developed to assist them. The significance of the study is to determine the relevance of traditional methods and to determine if there are easier, more concise and faster methods to conduct data collection and analysis in the field of industrial engineering.

Methods
A detailed survey will be used to collect the relevant data and the data will be analysed accordingly to determine the relevance of traditional methods in the technological age.

Results and Discussion
IE’s are not aware of the new solutions available and therefore tend to stick to traditional methods. The modern techniques are more efficient and accurate than traditional methods.

Conclusion
Traditional methods are relevant as baselines for the development of modern IE solutions which are more efficient and less manual. IE’s are not actively aware of advances within the field and therefore tend to stick to traditional methods even though it is inefficient.

Bhanu Jughoo is an Asset Care Engineer at Pragma, Midrand. She has recently graduated with a B-Tech in Industrial Engineering at the Durban University of Technology in September 2019. Bhanu is a young passionate professional that strives to live by the principles in the Industrial Engineering field. Bhanu believes that in order to continuously succeed, one needs to be mindful of and adapt to the rapid advancements sparked by IR4 and other factors within the industry.

A FRAMEWORK TO EMBED INSTITUTIONAL CAPACITY AT AN EARLY CHILDHOOD DEVELOPMENT CENTRE

A. de Boer, M. de Vries

Significant progress has been made in the South-African early childhood and Grade R spheres. However, South-Africa has a long way to go to meet the needs of the majority of its children. Institutional capacity refers to the administrative and managerial aspects of an Early Childhood Development (ECD) centre. Failure to build this capacity impacts the quality of services delivered to the most vulnerable children in our society. Literature is scant when it comes to the approach, as well as embedment of institutional capacity, especially in the ECD environment. The purpose of this article is to provide a systematic review on existing approaches and frameworks for developing institutional capacity within an ECD environment. As a second contribution, we extract knowledge from existing approaches/frameworks that could be used as a baseline for an institutional capacity development approach (ICDA) for early childhood development for a South African context. The ICDA should be be useful to South-African ECD administrators, if they intend to improve institutional capacity, resulting in dramatic improvement in quality of services delivered.

Andreas is an Executive Strategic Change and Business Transformation leader with 17 years' global experience across various sectors, especially Manufacturing, Consulting as well as Financial Services. With assignments across SE Asia, Europe, Middle East and Africa, Andreas has successfully led, built and established strategic transformation teams and programs for various organisations and markets. Andreas understands how enterprises are designed, orchestrated and should be engineered for optimal effectiveness using Enterprise Engineering frameworks. Andreas started his own consulting business and is now helping various SME’s to remain competitive and relevant.
RISK MANAGEMENT IN SUPPLY CHAIN INFORMATION FLOW: A STUDY OF SELECTED FOOD PROCESSING COMPANIES IN SOUTH AFRICA
O.E. Matlhoko and B. Emwanu
The purpose of this study is to examine how Food Processing Companies in South Africa manage risk pertaining to supply chain information flow. Eventually, this study will help in determining the impact of contemporary risk management in supply chain information flow. As the Food Processing Sector in the country continues to drastically grow and increase in its complexity, so do the problems encountered in that industry [1]. Examples of such problems include more dynamic, differentiated and complex consumer demand, distorted supply chain information flow, the need for effective practices and the need to meet the dynamic market requirements [2]; [3]. All these problems pose risks to the business performance and the supply chain management effectiveness, which results in escalated costs and declining competitiveness. Since information is a resource for decision making and keeps all supply chain components updated, it is important to investigate information flow risk factors and the mitigation strategies employed by Food Processing Companies to better understand developments within the industry. Continued research can help in solving several problems such as uncertainties in demand and supply, network system problems, poor customer service, high inventory levels and lost sales and decision making necessary for further growth and success in the industry [1].

RETAIL SUPPLY CHAIN MANAGEMENT: A STRUCTURED LITERATURE REVIEW
L. Stemmet, L. Louw and K. von Leipzig
This paper seeks to determine the current state of retail supply chain management (R-SCM) research by focussing on papers published over a ten year period between 2008 and 2017. The aim is to identify the most prominent themes in the area of R-SCM and to establish whether the topics were treated as a mere extension of general supply chain management (SCM) or focussed on the unique challenges of R-SCM. A systematic literature review approach was followed. First, prominent R-SCM authors were identified through a systematic review of academic journals in several scientific databases. Articles where then classified based on a retail value chain (RVC) process, and further analysed to identify the most prominent themes in each of the RVC categories. Five major themes emerged from the literature review, namely assortment planning, omni-channel, in-store logistics, forecasting, and Green SCM. R-SCM research is however still very much on the fringes of general SCM research. A larger body of research is required to provide a deeper understanding of these themes under different retail specific conditions, as well as end-to-end optimisation of the multi-echelon retail value chain.

Louis is a supply chain consultant with 22 years’ experience in the implementation of advanced planning systems at multi-national organisations. The last 12 years his focus has been on the implementation of SAP F&R at global retailers. This experience has highlighted the differences in supply chain challenges faced by retailers in comparison with manufacturers. He became fascinated by the lack of focus on these differences in the academic world, which has lead him to enrol for a PhD in Industrial Engineering with a topic titled “The organisational impact of multi-echelon replenishment in Retail.” He is currently in his 3rd year.
EVALUATING THE IMPACT OF E-COMMERCE FREIGHT MOVEMENTS IN SOUTH AFRICAN CITIES

E. Cilliers and W. Bean

E-commerce is rapidly increasing in supply chains with online shopping leading the way, increasing the number of freight movements. The impact of e-commerce on South African cities’ freight movements are not well known and needs to be researched. It is necessary to consider how e-commerce impacted other countries and how they embraced the resulting change and growth in traffic volumes, in order to understand how South African supply chains can take advantage of opportunities arising from the growth in e-commerce in the country. To this end, this paper conducts a systematic literature review, which focuses on determining how other countries’ urban areas were affected by increased e-commerce freight movements and how they managed it. The research is then considered on how it can be applied to urban South African supply chains. A conceptual solution for the way forward is also provided in order to provide guidance for better planning to accommodate future e-commerce growth.

Elizna Cilliers is an Assistant Lecturer at the Department of Industrial and Systems Engineering at the University of Pretoria. She assists with undergraduate modules such as Productivity; and Professional and Technical Communication. She obtained her undergraduate degree in Industrial Engineering at the University of Pretoria in 2017, completed her Industrial Engineering honours in 2018 and is currently busy with her Masters in Industrial Engineering.

SIMULATING VARIABLES THAT CAUSE DISTURBANCES ON ARTERIAL ROADS

Z. Mpanza and A. Nel

Disturbances on the roadways are a major issue in South Africa especially in busy arterial roads. The arterial roads are already facing severe traffic congestion on a daily basis. This is due to an increased number of people who have opted to reside in urban areas to be closer to their workplace, and this has resulted in an increased number of arterial road users. Arterial streets bear the predominant flow of traffic in the city because they connect important urban centres of activity and neighbourhoods to another. Added to this are disturbances that occur on the arterial road which further perpetuate the problem of congestion. The disturbances include amongst others taxis stopping for loading and unloading, street trading, and traffic lights malfunction. Also, in Johannesburg roads, there is a growing number of recyclers who pull trolleys. The recyclers make a living out of this as it is their source of income, but it unfortunately interferes with traffic flow. These disturbances tend to limit the drivers’ choice of speed thereby interrupting the traffic flow, which in turn reduces the entire performance of traffic operations. It is therefore important that the city develops new methodologies to assist in planning and analysing roadways to accommodate these types of disturbances. In this study, we identify all the factors that cause disturbances on arterial roads. We then simulate all these variables to measure their effect.

Zanele Mpanza is a lecturer in the department of Mechanical and Industrial Engineering at Unisa. Her research interests include optimization, modeling and simulation, and supply chain.

USING EXCEL SOLVER IN THE OPTIMIZATION OF PREPOSITIONED DISASTER RELIEF SUPPLY CHAIN IN A HUMANITARIAN OPERATION

J.-C. M. Baraka, S. Yadavalli, M. Dewa

In this research, a transportation problem is resolved using Excel solver. This study intends to optimize transportation time and cost solution in order to assist humanitarian operations to prepositioned Distribution Centre (DC) in Southern African Development Community (SADC) countries. The objective of this research is to develop a holistic approach to regional humanitarian supply chain including all countries and their available transportation modes. Following a number of assumptions and constraints, the results reveal that incorporating all SADC countries and their available transportation modes into the transportation problem optimize the region response capacity by minimizing transportation cost during a disaster relief operation.

Mr Mendon Dewa is a lecturer in the Department of Industrial Engineering at the Durban University of Technology. His research areas of focus include optimisation techniques and energy efficiency.
Assessment of high speed trains catenary wire for maintenance decision making

M. Lelala-Mnguni, D. V.V. Kallon

A catenary is a system of overhead wires used to supply electricity to locomotives and electric trains equipped with a pantograph. The electricity is delivered via the pantograph to the high speed circuit breakers and thus distributed to the different required systems. This study focuses on integrating a catenary tracer system that assesses the condition of the catenary wire (overhead wire) for maintenance decision making. The system consists of a laser scanner and data acquisition box mounted on the roof of the train, and speed sensors mounted on the bogies. The system is designed to continuously collect data from the catenary wire, to assess and to detect defects on the catenary wire. The data is analyzed and classified in three different defect categories: Yellow class – to be corrected during routine/preventative maintenance or to be corrected during standard B maintenance in the vicinity; Orange class - Conduct maintenance not later than 6 months and Red class – indicating danger, and closure of section for immediate attendance. The collected data is then loaded to the depot server and compared to a reference to determine if maintenance on the catenary wire is required. The assessment of the catenary wire leading to various maintenance decisions forms the focus of this paper.

Mpho Lelala Mnguni, currently work as a Mechanical lead Engineer - Fittings and Interiors at Gibela Rail since November 2016. Matriculated in 2006 from Residencia Secondary School in the Vaal, Graduated from Vaal University of Technology, N.Diploma , Mechanical Eng in 2012. And B-Tech Mechanical Eng in 2014. Worked as a learner technician at Knorr-Bremse SA from 2010 to 2011, and Junior draftsman from 2012 to 2013 in the Automotive department. And then was promoted to Draftsman in 2013 to 2014. And then worked in the rail department at Knorr-Bremse in 2015 as Mechanical design Engineer.

Session B3
Implementing Lean - The People factor

AN INVESTIGATION INTO KEY ENABLING FACTORS FOR THE SUCCESSFUL IMPLEMENTATION OF KANBAN SYSTEMS IN SOUTH AFRICA: A CASE STUDY
K. Ramdass and K. Mokgohloa

The manufacturing sector is considered to be a significant contributor to economic development in any country. It is often plagued with delivering measurable benefits in terms of efficiency and quality. With a continuous demand for value by customers and an increasing degree of competition, manufacturers are required to implement innovative strategies to maintain market share. In order to cope with this challenge, organisations attempt to improve their manufacturing operations by using different tools and techniques to reduce costs while remaining profitable. This study investigated the existing applications of Kanban systems of two different manufacturing organisations in South Africa. The objective of the study was to identify the strengths and weaknesses of the Kanban system in an attempt to improve quality and productivity. An empirical study was conducted using qualitative methodology. A simple questionnaire was developed to solicit information from shop floor workers and engineers of two chosen organisations. The results of the study showed that in both organisations there are similar and contributing factors that enable effective application of Kanban systems.

Prof Ramdass has worked as a work-study officer, industrial engineer, production/operations manager and skills development facilitator in the clothing, electronics, and textile industries between 1981 and 1999. He joined the academic profession in 1999 as a lecturer with Technikon South Africa. He later moved to UNISA'S Department of Business Management in 2006 lecturing in operations management. He is currently Associate Professor in the Department of Mechanical and Industrial Engineering based as Unisa, Florida Campus. He has a passion for quality and firmly believes that the application of quality management methodologies will highlight deficiencies and instigate the implementation of improvement strategies. He has applied continuous improvement methodologies from an industrial engineering, quality and operations management perspective. He is a process, performance and operations specialist with a driving passion for improving production, quality and competitiveness. He has authored and presented approximately 50 journal and conference papers both nationally and internationally and is a peer reviewer for numerous publications. He achieved Fellow membership status at SAIIE and is a member of PICMET and IEEE. He registered as Pr Tech Eng at ECSA and is appointed as a member of the Code of Practice Steering at ECSA.
APPLICATION OF LEAN PRINCIPLES IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

I. Maradzano, R.A. Dondofema and S. Matope

South Africa is a developing country investing billions of rands annually in the Construction Industry. The Construction Industry consumes resources and inevitably waste is generated during the process. Although numerous approaches have been developed to improve quality, efficiency and effectiveness in this Industry, lean principles offer the promise to minimize and/or eliminate non-value adding work thereby increasing value for the client. The paper highlighted lean construction tools currently used worldwide and the benefits of adopting lean construction. The study surveyed publications on application of lean principles in Construction Industry and identified tools yet to be implemented in South African construction industry with specific reference to electrical and mechanical engineering services. The study used systematic review methodology to identify different lean construction concepts and developed a lean implementation framework. The framework was then evaluated using a local case focusing on electrical and mechanical engineering services in construction industry. The improved framework after evaluation consists of eight steps.

Isabellah holds a B.Eng (Industrial Engineering) from the National University of Science and Technology, Zimbabwe and is currently pursuing a Masters Degree in Industrial Engineering at Stellenbosch University. Isabellah is currently working as a Consultancy Projects Engineer in Joburg. Her field of interest include lean construction, continuous improvement in building services and project management. She was working as a Mechanical Engineer at Anglo American Platinum Mine before joining Consultancy Industry. She is married to Richmore.

TOWARDS DESIGNING AN ARTEFACT EVALUATION STRATEGY FOR HUMAN FACTORS ENGINEERING: A LEAN IMPLEMENTATION MODEL CASE STUDY

R. Coetzee

Applying scientific methods for the evaluation of design science research artefacts is necessary to recognise the design process as design science research. Prior work has reported on this crucial evaluation component, however, limited information and guidance are available on the practices that should be followed. In this study, the Framework for Evaluation in Design Sciences (FEDS) and the eADR method within the design science research paradigm were used to develop an alternative evaluation strategy for a human factors engineering artefact. A different scientific method was used to design an evaluation episode, for each of the eADR iterations within the DSR paradigm: (1) a gap analysis, (2) a systematic literature review, (3) an applied thematic analysis, (4) a design requirements traceability matrix, and (5) the Delphi technique. The validity of the research design was proven by means of DSR guidelines, ADR principles and a research validation matrix. This evaluation strategy indicated how the strategic use of different kinds of scientific evaluations assisted in establishing the quality of the knowledge delivered by the design science process. This study has contributed to the field of (human factor) engineering by providing a pragmatic approach to solving abstract, people-related problems in industry. Designing different scientific evaluation episodes during the combination of the relevance cycle (to include industry input) and the rigor cycle (to ensure scientific research) resulted in an effective artefact to address an industry problem.

Dr Rojanette Coetzee is a senior lecturer at the School of Industrial Engineering at the North-West University. Her research interest includes human factors engineering with a focus on operations excellence and lean manufacturing.

Session C1
Product life cycles and value chains

A SYSTEMATIC LITERATURE REVIEW ON THE TITANIUM METAL PRODUCT VALUE CHAIN

R.N. Roux, E. van der Lingen and A.P. Botha

This paper presents a systematic literature review (SLR) on the titanium metal product value chain. Globally this value chain is fragmented, meaning that successive production stages rarely occur within the same country and information published on the value chain is limited. The aim of this review was to collect literature to create and elaborate on the titanium metal product value chain. The SLR followed a combined building block searching strategy and a criterion analysis to obtain relevant literature on production stages within the value chain. The value chain was based on the three main sections that comprise the titanium metal industry namely the raw material, processes & technologies and
the market. From the main sections, eight production stages were identified and discussed. These stages, as per the literature review, will be applied as a baseline to understand the requirements for improving the underdeveloped titanium industry in South Africa.

Nicolene is currently enrolled for her PhD in Technology Management at the University of Pretoria. Her study is sponsored and was motivated by the Titanium Centre of Competence (TiCoC) at the CSIR. Nicolene’s study is focused on the development of a roadmap for the South African titanium metal value chain. Prior to her work in titanium Nicolene’s main background was in the mining industry (mainly coal) as well as lecturing. Her interests are value chain & supply chain management, technology management & innovation, chemical engineering, mining, sustainability and energy.

4228 A FRAMEWORK FOR SUCCESSFUL NEW PRODUCT DEVELOPMENT
C. Pienaar, E. van der Lingen and E. Preis
To exploit the competitive advantage of a core competency, such as new technology development, an organisation must be capable of developing that technology efficiently and effectively. The purpose of this research was to study the new product development success and failure factors in a chemical company and recommend improvements to the existing new product development framework. The study is significant in that new product development performance need to be improved to remain competitive in the current economic and environmental climate. The same new product development model is applied to all projects in the company under investigation. Preliminary investigation suggested that the success rate of these projects fluctuate significantly. Qualitative case study research was conducted through semi-structured face-to-face interviews. A thematic approach was used to organise and interpret the interview data. As the data was coded, several sub-themes emerged, and from these themes critical success factors and critical failure factors were identified. All of these factors were discussed and compared against literature for relevance. The critical success factors and critical failure factors were divided into three categories, namely: Input Requirements, Stage Kick-off Guidelines, and Continuous Prompts. In this format these factors are recommended as potential improvements to the organisation’s existing new product development framework.

4288 A STRATEGIC FRAMEWORK FOR START-UP MEDICAL DEVICE MANUFACTURERS IN SOUTH AFRICA
I. Maharaj and B.P. Sunjka
An exploratory, qualitative study was conducted to establish why local medical device manufacturing firms are not starting up in South Africa. Semi-structured interviews were conducted with local medical device manufacturers to understand the market environment and competitive environment companies operates in, as well as elements of strategy implemented within these companies. The study concluded that local medical device manufacturers were not starting up in South Africa due to the high capital investment required, the prohibitive and unaligned regulatory framework, brand representation and the unwillingness of end users to switch to smaller brands as well as cash flow and liquidity problems experienced. Recommendations were made for start-up medical device manufacturers to mitigate any potential problems that may be faced as well as for future policy development of medical devices. Included in this, was the suggestion to realign South African medical device regulations to other successfully implemented regulations across the world.

Ishan is an associate director at Dynamed Pharmaceuticals based in Durban. He has developed a passion for medical devices, pharmaceuticals and their manufacturing processes. His research was conducted in the South African medical device manufacturing industry, addressing the challenges faced by local manufacturers. Outside of academics, Ishan is the vice chairman of DHS Rhythm Cricket Club and has attained provincial cricket colours from 2009-2011 in KwaZulu-Natal.
A GENERAL APPROACH TO DEVELOP AND ASSESS MODELS ESTIMATING COAL ENERGY CONTENT

C. van Aarde, A Gous and M Kleingeld

The energy content of coal is an important indicator for energy efficiency in industrial mining facilities. Energy content is quantified from the gross calorific value (GCV) but the measuring process can be time-consuming and expensive. More accessible variables are thus commonly used throughout literature as an alternative to model coal GCVs. Manifold such models already exist in literature, however, these models have major variations and use different modelling approaches. This makes the models’ results difficult to accurately and objectively compare. This paper considers the existing GCV models and ultimately presents an approach to develop new GCV models. This new approach includes fundamentals from industry “best practices” and allows for major variations such as type and conditions of coal. The presented approach therefore enables the objective comparison of model characteristics and subsequent results through visualisation techniques. New models developed using the presented approach delivered errors below 2.63%. This improved accuracy allows industrial mining facilities to accurately quantify the energy content of coal and ultimately improve mining efficiencies. The new and existing models could also be compared visually, and the new approach proved an overall improvement of the modelling process.

Miss Chantelle van Aarde holds a master’s in mechanical engineering from the North-West University. She is currently a doctoral student at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

EVALUATION OF THE EVAPORATOR SYSTEM OF AN ATMOSPHERIC WATER GENERATOR DESIGNED FOR RURAL KWAZULU-NATAL

S.K. Thisani, D.V.V. Kallon and E. Bakaya-Kyahurwa

Atmospheric Water Generators (AWGs) are a rapidly growing technology used to condense water vapour from air and produce drinking water. This study reviews the evaporator unit of a cooling condensation type AWG design and investigates the rate of water condensation across the evaporator at three climate conditions of the east coastal region of KwaZulu-Natal (the case study region) using first principal steady state calculations and Computational Fluid Dynamics (CFD) methods. The study findings illustrate the high dependence of AWG technology on climate conditions and suggest that operating an AWG system at temperatures of 15°C and below with 40% relative humidity can be considered to be beyond the effective operational limits of a cooling condensation type AWG. The study findings also suggest that AWGs can be effective at the high temperature climate condition of the case study region and could be an effective solution for high temperature drought relief of rural communities in the region.

Sandisiwe hails from Uitenhage in the Eastern Cape. He obtained his BTech in Mechanical Engineering from UJ, a BSc (Hons) in Technology Management from the University of Pretoria, and an MTech in Mechanical Engineering from UJ as well. His research interest lies in the sustainability of water. With five years of experience in the engineering industry, specifically in the water and wastewater treatment sector, Sandisiwe describes himself as a practical scholar who enjoys implementing knowledge gained from higher education to solve real-world problems, with the aim of contributing to innovation and the economic growth of South Africa.

FLOW PROPERTIES UPON TREATMENT OF ACID MINE DRAINAGE USING PERVIOUS CONCRETE

D.V.V. Kallon, S.P. Simelane and L. Mafanya

Mining industry is one of industries that have a positive influence on the economy of South Africa, however it has a damaging impact on the environment. The acid mine drainage which is known as AMD is one of the product of mining industry. Acid mine drainage is an acid rich-metal solution that is formed during mining operations. The shortage of water in South Africa calls for immediate intervention. Treating AMD will not only help to generate clean water, but it will also help to protect environment against AMD. some researcher has discovered that pervious concrete can treat amd, however there was no further investigation that established properties of pervious concrete that treat AMD. The aim of this study is to investigate and establish the relationship between flow rate of AMD through a porous medium such as pervious concrete and the thickness of pervious concrete wall. This is done in order to achieve a low
cost, yet effective method that can improve treatment of AMD for communities, especially in South Africa, affected by AMD. AMD samples are collected from South32 coal mine, which have high sulphate content, for laboratory testing. To predict fluid flow through pervious concrete as a medium, a various test is developed on cubes of pervious concrete. The results show that as AMD is filtered through the layers of pervious concrete precipitates of heavy metals may be removed. The pervious concrete layers also help to increase PH level of AMD to more acceptable values making concurrent absorption and neutralization a possible alternative

Lindelwa Mafanya accepted her B Tech in the field of Mechanical engineering from University of South Africa and is currently in final year of Masters with the University of Johannesburg. She served as a project manager in a waste water treatment industry that is where her interest in water treatment research grows.

Session C3
Decision making

4145  THE USE OF ANALYTICAL HIERARCHY PROCESS (AHP) FOR WELDING PROCESS SELECTION DURING RAIL CAR MANUFACTURING
I.A. Daniyan, K. Mpofu, A.O. Adeodu
The welding process is a complex manufacturing process, which requires the deployment of multi-criteria decision support system amidst complex and conflicting welding processes, emerging technologies and materials. The Analytical Hierarchy Process (AHP) was employed for the investigation of the most suitable welding process for the assembly of the body shell of the rail car. The process attributes ranked include; crash worthiness, structural integrity, end of life, materials and its cost, welding position and joint orientation, weld quality, thickness of part, rate of material deposition as well as the welding cycle time. The development of the decision support system starts with the development of a conceptual framework that defines the goal, criteria, welding methods as well as their interconnectivity. This was followed by the ranking of sets of alternatives and subsequent comparison by identifying the weights for each criterion while the difference between the alternatives and the ideal solution was determined. The successful completion of this work provided the integration of conceptual and mathematical support system into an organized approach for solving multi criteria decision for the rail car development. This will simplify the decision making process, promote the production effectiveness and enhance overall production cost through the deployment of the best technique.

Daniyan Ilesanmi Afolabi is a Postdoctoral Research Fellow in the Department of Industrial Engineering, Tshwane University of Technology. I am presently engaged in the reconfiguration of existing jigs and fixtures for welding operations during rail car manufacturing. My research field include: Production Engineering, Advanced and Additive Manufacturing, Reconfigurable Manufacturing Systems, Automation and Robotics as well as Renewable Energy.

4152  A SYSTEMS APPROACH TO OPERATIONAL AND BUSINESS DECISION MAKING
P. Pretorius
The PQ problem was published back in 1990 by Goldratt. This problem is provided to master’s level students a few weeks before starting an Operations Management course. The performance statistics collected from three South African (since 2016) and one European business school (from 2018 onwards) do not make for good reading. Until now only 2.3% (42 students from the sample of 1 866 students) were able to answer both questions correctly. In addition, some of the students were not able to justify their correct decisions. This paper will explore the differences between traditional, cost-based methods of decision making for day-to-day operational- and improvement decisions as practised by many companies today, hence the bad performance by the students, and taking a systems approach to decision making. The paper will argue for taking the systems approach as a real alternative without which alternative realities will just remain a dream.

Pieter Pretorius is a freelance educator and consultant. His IE undergraduate studies were completed in 1984 and has also completed an MBA and PhD (IE). After initially working in industry, he spent 16 years as full-time faculty at UP, after which he became an independent educator and consultant in 2007. He is teaching at various leading South African business schools, as well as a prestigious school in the Netherlands. He has a special interest in systems thinking, fuelled by his exposure to TOC and Eli Goldratt himself. Personal interests include music, choir singing, cycling, traveling and DIY.
Southern African Development Community (SADC) has seen an increase in drought disasters in the past decades causing thousands of livestock’s death, and triggering major foods, water shortages with related impacts on livelihood and businesses. With future prediction pointing toward aggravation of climate variability, this research intends to provide SADC and the world with a practical decision making mechanism capable of enhancing the effectiveness and efficiency of the regional relief operations. The study aims to optimize the pre-positioned relief supplies and demands in facility locations across SADC. The objective is to upgrade the regional humanitarian disaster planning and the drought disaster response capacities. The multi-criteria decision making (MCDM) and location criteria for site selection are utilized to minimize the multiple relief items, response times, capacity restrictions while maximizing the satisfied relief demand to the pre-positioned destinations.

Mr Mendon Dewa is a lecturer in the Department of Industrial Engineering at the Durban University of Technology. His research areas of focus include optimisation techniques and energy efficiency.

Session D1
Industry 4.0 Readiness

Technological advancements related to the fourth industrial revolution are causing disruptive changes that are universally felt at national, industry and company level. Industry 4.0, an initiative driving the fourth industrial revolution, is happening at an exponential speed and embracing and adopting it is unavoidable for survival and competitiveness. Though noticeable progress has been made in the use of Industry 4.0 technologies, systems and processes in developed countries, there is uncertainty about the preparedness of businesses and industries in developing countries, including South Africa, to adopt Industry 4.0. The purpose of this research paper is to explore the readiness of South African industry in this regard. A questionnaire instrument with quantitative criteria compiled by the Impulse Foundation of Verband Deutscher Maschinen- und Anlagenbau was utilised in this study. The explorative study revealed that South African industry is faced with significant challenges in Industry 4.0 strategy formulation and equipment infrastructure to support Industry 4.0 requirements. The assessment pointed out that Industry 4.0 skills in South Africa exist in pockets and a further study to reveal more detail on Industry 4.0 skills requirements is essential.

Mr Whisper Maisiri is a Mechanical/Industrial Engineer and holds M. Eng in Mechanical Engineering (North-West University, South Africa) and B.Eng. (Hon) degree in Industrial and Manufacturing Engineering (National University of Science and Technology, Zimbabwe. He possesses Certified Energy Manager International (CEMI) certification and post-qualification experience in energy efficiency projects and industrial process performance optimisation. Currently he is pursuing a Doctor of Philosophy in Industrial Engineering with (North-West University, South Africa) under the supervision of Prof. Liezl van Dyk. His research focus is on Fourth Industrial Revolution and Industry 4.0 skills development in South Africa.

Revolutionary advances in the Information and Communication Technology (ICT) field, paved the way for this high-tech strategy. Rapid growth and expansion of the Internet as well as technical advances in the area of sensor technology, allow for the interconnection of physical objects for the purpose of achieving collective goals, which paves the way for the Fourth Industrial Revolution. The Industry 4.0 paradigm is a relatively new concept that still requires detailed investigation and discussion. This is especially important if global industrial adoption is to take place. Standards, technologies and overall guidelines need to be presented, hence, this review paper aims to address key questions to provide some clarity on navigating the tides of Industry 4.0. The aim of this paper is to investigate and present the underlying architecture of Industry 4.0 to determine the readiness of the South African mining sector for Industry 4.0 adoption. The key enabling technologies and the extent in which these technologies can be applied in
industry to achieve the fundamental goals of Industry 4.0 is also presented and discussed. Current challenges that hinder Industry 4.0 adoption in the South African mining sector is also discussed and a short discussion on the way forward is presented. In short, this article aims to present a detailed roadmap for the implementation of Industry 4.0 methods in the South African mining sector. From the literature, a digital framework and toolbox has been compiled to serve as a roadmap for the way forward in successful Industry 4.0 adoption. The proposed framework and toolbox are presented, with a theoretical case study.

Mr. Jaco Prinsloo holds a B.Eng. degree in Computer Engineering. He is currently enrolled for his Masters studies at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

4337  AN ANALYSIS ON THE EXTENT TO WHICH INDUSTRY 4.0 HAS BEEN CONSIDERED WITHIN SUSTAINABILITY OR SOCIOTECHNICAL TRANSITIONS
M.M. Asiimwe
A growing database of literature exists that is geared towards the analysis and evaluation of Industry 4.0. One of the points of interest is the assessment of Industry 4.0 within the context of sustainability and sustainable development. However, there seems to be a gap in literature that focuses on the transitions to more sustainable states which are evidently fostered by sociotechnical [system] transitions sometimes referred to as sustainability transitions. This presents the need to evaluate the interfacial layers of these disciplines, given the larger challenge of sustainability and Industry 4.0’s potential to support complex problem solving. This paper presents a bibliometric analysis of literature that jointly considers the concepts of sustainability, sustainable development, sociotechnical systems and the transitions thereof with Industry 4.0.

Martha is a Ugandan, 1st year Masters student at the Industrial Engineering department in Stellenbosch University. She is undertaking research within the direction of sustainable systems.

Session D2
Managing people

4142  FRONT-LINE SUPERVISOR EFFECTIVENESS ASSESSMENT ON AN ENGINEERING SHOP-FLOOR
P.N. Zincume and J. Romon-Maneveld
This paper entails the creation of a Front-Line Supervisor Effectiveness Assessment Model on an Engineering Shop-Floor. Supervisors were assessed according to assessment criteria to evaluate their performance and effectiveness as Front-line Supervisors. Criteria were determined from literature and documentary research. The paper states how these criteria were determined and why they are relevant. The model consists of 38 assessment criteria by which Front-line Supervisors are assessed at a specific engineering company. Furthermore, the model created is demonstrated and validated by implementing the model. Lastly, various recommendations are made on how to improve the model.

Philani Nduna Zincume is a lecturer at the Stellenbosch University in the department of Industrial Engineering. He holds a BSc degree in Electrical Engineering and a Masters degree (cum laude) in Engineering Management both from the University of Cape Town, South Africa. He is currently working towards a Ph.D. degree in Engineering Management at Stellenbosch University. Before joining Stellenbosch university as a lecturer, he worked as a production manager and has nine years of experience managing engineering work teams. His principal research interests include Human Systems Engineering, Engineering Work Teams, Frontline Supervision, Production Management, Systems Thinking, and Rail Engineering.
4162  BALANCING LEADERSHIP STYLES BASED ON PROJECT TYPE AND LIFE CYCLE PHASES: A MODEL

S. Pretorius, H. Steyn, T. Bond-Barnard and T. Cronjé

With the current trend towards empowered teams, hierarchical company structures are increasingly being replaced by team-based ones. As a result, a shift in the classic understanding of leadership is needed and research on leadership in project management is increasing. Two major concepts have developed in recent years: shared and vertical leadership styles. This paper reports on the development of a new Model of leadership styles that considers the effect of project types and the project life cycle phases on leadership style (vertical versus shared leadership), and how an appropriate balance between the two styles influences the likelihood of project management success. A web-based questionnaire yielded 313 complete responses and the data was analysed using hypothesis testing. Based on this empirical work and relevant literature, a novel Model is proposed. The Model explains how project types and life cycle phases influence the appropriateness of different leadership styles, and it guides the practitioner to selecting appropriate leadership styles for specific situations. Recommendations for furthering the model are discussed.

Suzaan Pretorius is a researcher at the Graduate School of Technology Management (GSTM) at the University of Pretoria. She submitted her final PhD Thesis for examination at the end of July. The title of the Thesis is "The Effect of Project Types and Project Life Cycle Phases on Leadership Styles". As a result of her PhD research, two journal papers and one conference paper have been published, and another two journal papers have been submitted. Other fields of interest are project management organisational maturity, knowledge management, agile project management and project management in the South African financial services industry.

4277  A SKILLS MEASUREMENT MODEL FOR THE SOUTH AFRICAN ENERGY SECTOR: APPLYING THE ANALYTIC HIERARCHY PROCESS TO THE SA ELECTRIC POWER INDUSTRY

M Meyer and B.P. Sunjka

The need to understand the skills value inherent in a project in the South African electrical power sector lies at the core of addressing various skills related challenges in this sector that can hamper effective implementation of projects. In this study a model was developed based on the Analytic Hierarchy Process (AHP) whereby three different power generating projects were compared to one another as to their skills values. The purpose of this was to analyse projects during the feasibility stage for their skills value, because a financially feasible project might still not be implementable if the skills do not exist to implement it. Three options were compared to the sub-criteria along with each sub-criteria's priorities and the overall ranking were derived. A sensitivity analysis was carried out to determine the validity and accuracy of the final result. The final ranking had coal-fired power at first position followed by nuclear and solar.

Bernadette Sunjka is the Head of the Industrial Engineering Stream and a Senior Lecturer in Industrial Engineering at Wits University. She has completed a PhD in Supply Chain Risk Management in South African Manufacturing SMEs. Her other research interests include Risk and Project Management.

Session D3

Data management and reporting

4176  IMPROVING DATA MANAGEMENT FOR ENVIRONMENTAL REPORTING IN THE GOLD MINING INDUSTRY

H.M. Janse van Rensburg

Imagine an alternative reality where South African gold mines are environmentally sustainable. Environmental reporting is a realistic alternative for mines to prioritise operational changes in crucial environmental areas. There are multiple platforms where gold mines are reporting e.g. Integrated Reporting. All these platforms have created the need for effective environmental data management. A methodology was developed where the environmental performance data for numerous operations is centralised. A standardised reporting procedure was developed for each environmental data category and includes the different stakeholders needs. Focus was also placed on reducing the data transfer errors, due to the importance of data accuracy. The methodology is based on the Plan-Do-Check-Act cycle (PDCA cycle) and was implemented at a gold mining company. After implementation, the rate of transfer error that would have been recorded in the data was reduced from 20 % to 4 %. This error was recorded before an external audit took place.
Mrs Maryke Janse van Rensburg holds a Masters in Mechanical Engineering from the North-West University. She is currently enrolled for PhD at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

A FRAMEWORK FOR STANDARDISED INDUSTRIAL PROCESS DATA REPORT STRUCTURING

S. Taljaard, S.G.J. van Niekerk and J.C. Vosloo

Industrial processes generate vast amounts of data. If relevant data is captured and analysed, useful information can be extracted. Through reporting and dashboarding, this information can be used for informed decision-making. Although business intelligence tools allowing effective reporting exist, spreadsheet software, like Microsoft Excel, is still widely used instead. This is despite the disadvantages of using a tool that is not specifically designed for reporting. One of the main disadvantages is that report set up is often non-standardised, making it difficult and time-inefficient for persons to maintain reports they are unfamiliar with. This paper presents a framework with which reports can be structured. The framework is a method for defining all report data sources and content. It also defines how data and content are linked. The framework has been applied to a South African mining group. 36 report templates were generated adhering to the standard. With all report data sources and content being defined in a standardised and structured manner, the report generation, standardisation and approval process was expedited.

Mr Stéphan Taljaard holds a bachelor’s degree in chemical engineering, and master’s degree in mechanical engineering from North-West University. He is currently enrolled for his PhD studies at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

ALTERNATIVE DATA STRUCTURES FOR IMPROVED ENERGY REPORTING AND BUDGETING ON GOLD MINING GROUP OPERATIONS

A. Ferreira, P.F.H. Peach and J.F. van Rensburg

Accurate internal energy-use reporting on large gold mining groups remain vital to ensure correct budgeting and adequate tracking of financial performance of operations and systems. Metering errors are unfortunately a reality of this monitoring process, affecting everything from single sub-systems on small operations, to the entire group’s financial performance review. These types of errors also have an accumulating nature, becoming larger if left unaddressed. The energy reporting structure of a gold mining group with a budgeted electricity bill of approximately R 3-billion was investigated for the purposes of this research. It was found that due to compounding errors in sub-system metering, average errors of up to 8% (R 236-million) were identified in relation to the total consumer electrical sub-station measurements (Eskom billing meters). This led to erroneous reporting of sub-systems’ progressive electrical performance (daily resolution), as consumer sub station measurements were only available once per billing cycle (monthly). A methodology was developed to normalise sub-system metering data more regularly with check metering data which was available on a daily basis. This daily normalisation was implemented on a division of the mining group using an automated daily reporting system and displayed on an online dashboard. The average daily sub-system error displayed on the online platform was reduced by 6.9%, paving the way for an alternative energy reporting system and improved budgeting. This error reduction equates to approximately R 55-million per annum, that can now be allocated under the correct low-level sub system budgets.

Mr. P.F.H. Peach holds a M.Eng degree in mechanical engineering from the North-West University. He is currently enrolled in his PhD studies at the North-West University’s Centre for Continued Research and Engineering Development (CRCED) in Pretoria.
Session E1  
Managing assets

4146  
DEVELOPMENT AND PERFORMANCE EVALUATION OF A HUMIDITY MEASUREMENT BENCH  
I.A. Daniyan, A.O. Adeodu, K.A. Idris and K. Mpofu  
This work focuses on the measurement of humidity and airflow to ensure a comfortable atmospheric environment for both humans and machineries. The aim is to develop a bench that traps air which is blown out from a duct fan while air flow and the amount of water vapour in the air (humidity) is measured using a hygrometer, anemometer and a manometer. A bench that taps air and would effectively give a result with the accuracy of a precision thermometer for dry and wet bulb temperature calibration was developed. The materials employed for the development include; galvanized steel sheets, which was folded into a rectangular box for the housing of the measuring instruments and square pipes used for the frame and legs of the bench. The accuracy of the thermometer is ±0.05°C and resolution is 0.01°C. The findings of this study were confirmed using a temperature probe and measurement indicator. Test results revealed that effects of different parameters of the psychrometer in the measurement accuracy and stability of relative humidity.

Daniyan Ilesanmi Afolabi, is a Postdoctoral Research Fellow in the Department of Industrial Engineering, Tshwane University of Technology. I am presently engaged in the reconfiguration of existing jigs and fixtures for welding operations during rail car manufacturing. My research field include: Production Engineering, Advanced and Additive Manufacturing, Reconfigurable Manufacturing Systems, Automation and Robotics as well as Renewable Energy.

4147  
BUILDING BLOCKS FOR CONTINUOUS IMPROVEMENT: RESULTS OF THE ENERGY MANAGEMENT PILOT PROJECT IN SOUTH AFRICAN FOUNDRIES  
D. Mc Queen, K.D. Nyembwe, T. Sithole  
The manufacturing industry is one of the cornerstones of hope for a brighter future in Africa, and is pivotal in ending poverty through the creation of decent work [1]. The challenge of globalisation, rising input costs, a changing world with new technologies, the fourth industrial revolution, as well as a lack of skills, make this dream difficult to attain [2, 3]. Business often looks to changes in government policies or legislation to reduce input costs or to protect markets; or, alternatively, how to secure funding to invest in new technologies, as a quick-win solution to improve competitiveness. In times of economic distress, business often overlooks the power of continuous improvement to become globally competitive. The South African foundry industry is a classic example of a mainly SME industry in distress, supported by various government programmes to improve competitiveness [2]. The Innovation Hub funded a pilot energy management project to assist foundries to reduce energy costs. The purpose of this paper is to evaluate this pilot project through the lens of continuous improvement. It firstly gives an overview of the South African foundry industry and the challenges related to energy costs and then reviews Deming’s contribution to the understanding of continuous improvement and learning. Finally, we discuss the pilot project according to the PDSA cycle and highlight how we used elements of Industry 4.0 to complement the PDSA cycle.

Dalmari Mc Queen is the founder and Managing Director of Concepts 4.0, a knowledge-based company working at the intercept of people, systems and business with the aim of improving the competitiveness, sustainability and growth of the South African Manufacturing Industry. Dalmari is an Industrial Engineer with extensive experience in the South African Iron Foundry Industry, both mass production and jobbing environment. She utilises creativity, leadership, technical expertise and team work to perform industrial research, design and execute solutions to create customer value and solve business challenges. In Concepts 4.0 she is living her dream of enabling and nurturing people through promoting lifelong learning and collaboration.
Deep-level mining is under severe financial pressure due to several unique challenges. One of these challenges is maintaining acceptable underground temperatures for humans to work in whilst achieving demanding production targets. As mines regularly reach new depths, additional heat is added to the system, contributing to this problem. Accurate mine heat load studies are therefore required to ensure that heat sources are actively evaluated, managed and mitigated through adequate cooling practices. However, present heat load models are based on design parameters which cater for worst case scenarios. Most of these models are also based on outdated empirical data taken at a time when mining differed from the present. Industry 4.0 technologies provide potential optimisation benefits when integrated with new heat load models to ensure effective monitoring and consequently dynamic management of heat sources. The roll out strategy presented in this article will serve as a real alternative to previous outdated heat load prediction models.

Diaan Nell holds a master’s in mechanical engineering from the North-West University. He is currently a doctoral student at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria. Currently, Diaan acts as a service delivery project manager on a number of gold mines.

Session E2
People - Change, Fear and Queues

THE IMPACT OF CHANGE MANAGEMENT STRATEGIES IN ENHANCING ORGANIZATIONAL PERFORMANCE: THE CASE OF NPWP PUBLIC ORGANIZATION

P. Nyelisani, K. Ramdass and K. Mokgohloa

The study explores the impacts of change management strategies on organisational performance at a National Department in Pretoria. The Department underwent strategic change that was informed by findings from the diagnostic report that highlighted key challenges. Reports on the progress of the strategy indicated leadership instability and ineffective change management that led to the failure of previous change initiatives. The main objective of this study was to identify which change management strategies are in place, what factors affect the strategies and how they impact the organisational performance. The investigation was quantitative in nature using probability as a sampling method and questionnaires as the instrument for data collection. The results were analysed according to responses against duration of service and positions as variables. The results from the survey indicated that factors affecting change management at were the lack of an effective communication plan, lack of leadership influence to drive change, resistance to change, ineffective engagement and consultation with employees, lack of resources, training, and lack of performance management programmes. These factors affected the individual performance and overall organisational performance. Impacts of concern were employee morale created by lack of support from management, lack of consultations that created uncertainty on job security and satisfaction and no value of the change realised.

Prof Ramdass has worked as a work-study officer, industrial engineer, production/operations manager and skills development facilitator in the clothing, electronics, and textile industries between 1981 and 1999. He joined the academic profession in 1999 as a lecturer with Technikon South Africa. He later moved to UNISA’S Department of Business Management in 2006 lecturing in operations management. He is currently Associate Professor in the Department of Mechanical and Industrial Engineering based at Unisa, Florida Campus. He has a passion for quality and firmly believes that the application of quality management methodologies will highlight deficiencies and instigate the implementation of improvement strategies. He has applied continuous improvement methodologies from an industrial engineering, quality and operations management perspective. He is a process, performance and operations specialist with a driving passion for improving production, quality and competitiveness. He has authored and presented approximately 50 journal and conference papers both nationally and internationally and is a peer reviewer for numerous publications. He achieved Fellow membership status at SAIE and is a member of PICMET and IEEE. He registered as Pr Tech Eng at ECSA and is appointed as a member of the Code of Practice Steering at ECSA.
FEAR, THE GREAT ENEMY
S. Chatur and D. Hartmann

The delivery of health services is a legal, but also a moral, duty of government. To improve health delivery, many industrial engineering interventions have been undertaken, both globally and in South Africa. This paper presents one of our recurring discoveries: fear of improvement in health systems. It is used as a management strategy and as a result we have found that the pursuit of improvement is significantly and repeatedly compromised by unnecessarily vicious management approaches which lead to lower employee autonomy, reduced initiative and sense of ownership by the agents operating in the health system.

Sabrina Chatur is a Lecturer of Operations Management in the Department of Industrial Engineering at the University of the Witwatersrand. Her current research focuses on understanding how to design healthcare operations for the efficient provision and delivery of health care services to patients and communities.

PROACTIVE SERVER ALLOCATIONS IN SINGLE QUEUING SYSTEMS
G.J. Cox and J.H. Bührmann

This study investigated methods to decrease the waiting times for customers standing in line to pay for groceries at a local supermarket by using forecasting techniques to predict the number of servers needed ad hoc. The aim of the study is to better control the queuing time of a customer being serviced in a single queue multiple server system with the use of AnyLogic software. This was done by allowing an algorithm to assign capacity to the service stations automatically after a specified time frame. The most optimal model was one that used the exponential smoothing formula to predict the next waiting time for the next period. In doing so, the model became proactive in assigning service station capacity.

Dr. Joke Bührmann is a senior lecturer in Industrial Engineering at the University of the Witwatersrand specialising in Operations Research and Machine Learning. She has industry experience in areas including business analytics, data and optimisation analysis, business intelligence and application development.

Session E3
Opportunities in the workplace

USE OF SCIENTIFIC ERGONOMIC PROGRAMS TO IMPROVE ORGANISATIONAL PERFORMANCE
R. Roopnarain, M. Dewa and K.R. Ramdass

The packaging industry is characterised by ineffective ergonomic programs that are inadequately implemented thereby failing to yield benefits in the organisations overall performance. The aim of the study is to determine an effective scientific ergonomic program that aims to improve the organisations overall performance by aligning these programs with the organisations business strategy. A quantitative analysis was conducted at two sites of a packaging liquid company in South Africa using a sample of 70 participants from the production and engineering departments. It was found that several factors hindered the effective implementation of ergonomics in the packaging industry, and these include awareness, human computer interaction, job task design, poor implementation of anthropometric and physiological factors, poor communication and disconnection between employees and organisational strategies. It was recommended that the organisation should orientate and train employees on ergonomics best practices to create an effective program that will address operational gaps and enhance the organisations overall performance.

Riashna Roopnarain is a Project Engineer at Pragma with six years’ work experience in the field of Asset Management. She was previously employed as an Asset Care Engineer at the Pragma Africa and International region and her work revolved around the implementation of Asset Management best practices to improve the clients assets overall performance and efficiencies. She obtained her BTech degree from the Durban University of Technology and is currently completing her Masters in Industrial Engineering. She is passionate about business process improvement and data analysis, hence the outcome of her research aims to create a working environment that is productive, safer and an efficient place that helps employees work at their optimum.
IMPACT OF A WORK PLACE ORIENTATION WORKSHOP ON ENGINEERING STUDENTS’ WORKPLACE READINESS

A.S. Lourens and M. Dolley-Ryneveld

One of the strengths of the engineering national diplomas has always been the work integrated learning (WIL) component as it provided valuable industry exposure to students and assisted them with workplace integration. Informal feedback from students, prior to embarking on the compulsory one-year WIL, indicated that many felt fearful of and unprepared for the realities of the working world. To address this, a Workplace Orientation Workshop (WOW) was designed and presented to final-year industrial engineering (IE) students. The aim of the WOW was to better understand the concerns and expectations of IE students and provide them with practical co-curricular advice to prepare them for the workplace. Results of the data collected from post-WOW questionnaires in 2017 and 2018 indicated that the workshops had successfully addressed student concerns and contributed positively to their workplace preparation. The exclusion of the WIL component from many of the new engineering programmes curriculated in the new Higher Education Qualifications Sub-Framework (HEQSF) has resulted in a lack of pre-graduation work experience and workplace exposure. Hence, this research contributes to informing higher education institutions (HEIs) that co-curricular interventions are necessary to better prepare students for the workplace and work-life balance.

Mieshkah Dolley-Ryneveld is a Lecturer in the Department of Industrial Engineering at Nelson Mandela University. Prior to joining academia, Mieshkah was a practising Industrial Engineer in the automotive industry for eight years. Her experience includes Production Scheduling, Material Handling Engineering, Material Readiness and Project Management for the implementation of Total Productive Maintenance. Mieshkah completed a Bachelor in Technology: Industrial Engineering and thereafter graduated with a Master in Business Administration (MBA). Mieshkah’s research interest lies in the field of Industrial Engineering. Mieshkah will present her first paper at the SAIIEnexXXt Conference.

Dr Ann Lourens obtained undergraduate qualifications in Operations Management followed by MBA (Cum laude) and DBA. Prior to a career in academia at the former Cape Technikon (Cape Town) and Nelson Mandela University (Port Elizabeth), Ann worked in various manufacturing industries in operations related positions. As an academic, Ann lectured a variety of modules on the Operations Management, Industrial Engineering, and MBA programmes. Ann has a keen research interest in students’ (particularly women engineering students) development and retention and to this end has developed and managed several co-curricular interventions. Since 2011, one such project has been the design and management of the Women in Engineering Leadership Association (WELA) focussed on developing, supporting and mentoring women engineering students. As Head of Department and member of the Industrial Engineering team at Nelson Mandela University, close links are maintained with industry and several short learning programmes have been designed to develop employees representing various industries in and around the Eastern Cape.

DECODING LINE BALANCING AS A LEAN STRATEGY IN ASSEMBLY LINE BALANCING: A CLOTHING MANUFACTURING PERSPECTIVE

K. Ramdass and K. Mokgohloa

The study critically evaluates the functioning of line balancing as a lean application in clothing assembly production. Lean thinking and its principles are successfully applied to the manufacturing and operational environment to harness improvement and productivity. In today’s world, it has become increasingly important for companies to be able to compete on a global competitive market. Customers are constantly looking for manufacturers that can produce high quality products at an affordable price, faster, and meet all of their requirements. For companies to be able to compete at optimum level, the production facility is required to balance the line optimally in order to achieve maximum output. Line balancing is part of lean methodology, and has been increasingly popular in the clothing industry, because it offers organizations a proven sensible path to long-term sustainability. However, due to the shrinkage of the industry, many manufacturers decided to abandon the application of work-study principles. The purpose of this paper is to decode the application of assembly line balancing in the clothing industry through the application of case study methodology to provide a fundamental basis for productivity improvement.

Prof Ramdass has worked as a work-study officer, industrial engineer, production/operations manager and skills development facilitator in the clothing, electronics, and textile industries between 1981 and 1999. He joined the academic profession in 1999 as a lecturer with Technikon South Africa. He later moved to UNISA’S Department of Business Management in 2006 lecturing in operations management. He is currently Associate Professor in the Department of Mechanical and Industrial Engineering based as Unisa, Florida Campus. He has a passion for quality and firmly believes that the application of quality management methodologies will highlight deficiencies and instigate the implementation of
improvement strategies. He has applied continuous improvement methodologies from an industrial engineering, quality and operations management perspective. He is a process, performance and operations specialist with a driving passion for improving production, quality and competitiveness. He has authored and presented approximately 50 journal and conference papers both nationally and internationally and is a peer reviewer for numerous publications. He has achieved Fellow member status at SAIIE and is a member of PICMET and IEEE. He is registered as Pr Tech Eng at ECSA and is appointed as a member of the Code of Practice Steering at ECSA.

Session F1
Service industries in the spotlight

4171 INVESTIGATING THE ROOT CAUSES OF LONG LEAD TIMES IN THE AUTOMOTIVE AFTERSALES INDUSTRY BY MEAN OF THE LEAN PHILOSOPHY: A SOUTH AFRICAN CASE STUDY
M. Mangaroo-Pillay, R. Coetzee and E. Davies
The aftersales service industry has the potential to produce 80% of an organisation’s profit, although most only generate 20%. Similarly, the organization, used as a case study, struggles to achieve their operational performance indicators (OPIs) and the consequent profit margins. The aim of the study was therefore to investigate the root causes and develop corresponding preventative actions. The research followed a DMADV (Define-measure-analyse-design-verify) approach, uniquely designed by integrating specific methods: Gemba walks defined the scope of the problem and aim; The root causes determined by a 20-Key audit and five-why analyses were reported in a thematic map; Potential solutions were developed utilising Kernel theories, and verified via the Delphi technique. This study points out the many challenges, such as low employee morale and high staff turnover rates, when implementing a German adaptation of a Japanese philosophy (Lean) in the South African service industry, emphasizing the misunderstanding of lean principles. Furthermore, it highlighted the implications of a cross-cultural adaptations of lean, within organizational cultures.

Mia Mangaroo-Pillay is an Industrial Engineer, who is currently lecturing for the School of Industrial Engineering at the North-West University. Her research interests are predominantly in Human factor Engineering, within the Operational Excellence research sphere. Her most recent work focuses on addressing the misunderstanding of Lean management principles.

4246 A PATIENT-CENTRIC SIX-SIGMA DECISION SUPPORT SYSTEM FRAMEWORK FOR CONTINUOUS QUALITY IMPROVEMENT IN CLINICS
S.N. Hlongwane, C. N. Ngongoni and S.S. Grobbelaar
Primary Health Care facilities are widely regarded as the backbone of the South African Healthcare system. For this reason, formalised standards such as the Ideal Clinic and National Core Standards dictate expected service levels for clinics. Though this is a big step towards the improvement of service delivery at the facilities, the level of uptake of, and adherence to, these standards are concerning. Service quality plays a huge role in the level of patient satisfaction and emphasis is placed on the features of quality that are of importance to the patient. To this end, the patient focus is an important dimension in Healthcare Quality Management in order to improve the service quality in healthcare facilities. This article provides an overview of quality and how it is managed in the context of clinics in South Africa. It outlines the gaps aligned with how well quality is managed from a patient perspective. The paper proposes a decision support framework aimed at continuous improvement of quality in clinics. The tool was developed using the Six Sigma methodology, complemented by service quality assessment instruments. The structure of the tool provides an integrated systematic approach that can assist the healthcare decision-maker in tracking continuous improvement of processes and activities in clinics. The tool also makes the first step towards digitising a typically paper-based system.

My name is Sanelisiwe Hlongwane. I was born in Pietermaritzburg, KwaZulu-Natal to a mother from Mphophomeni and a father from Mphendle. As a product of Pietermaritzburg public schools I became the first generation in my family to attend Stellenbosch University in 2015, which has been the fuel that has driven me to get to where I am today. I am currently a Master’s candidate at Stellenbosch University, where I’m completing my thesis which focuses on the improvement of public healthcare.
IMPROVING CUSTOMER SERVICE THROUGH FMCG MANUFACTURING FIRMS IN GAUTENG: A SERVITIZATION APPROACH
J. Mathabatha and B. Emwanu

This paper recognizes how FMCG manufacturing firms in Gauteng, deliver the best customer service in moving from product-centric to service-oriented. The cross-functional relationship between products and services is crucially evolving and there is a need for FMCG manufacturing firms to embrace these service orientations in order to deliver surpassing customer service, hence the need to determine how the customers can be fully integrated into manufacturing to measure the influence regarding the customer services outcome of the products paramount. According to the findings of the study, the interviews conducted with Research and Development specialists on two categories in FMCG, namely food and home and personal care, have revealed that servitization is paramount to most of the FMCG manufacturing firms and is seen as something that creates value to their customers. While 65% of the participated FMCG manufacturers said to be on servitization track, about 35% were found not pursuing the servitization journey due to limitations such as capital investment, negative return on investment and inadequate service strategies. The theoretical implications of the findings according to (Kindstrom, 2010) is that the limited interactions between suppliers and customers will thus have a negative impact on the enhancement of relationships meant to facilitate an improved customer sensing and information gathering.

UNDERSTANDING THE IMPACT AND APPLICATIONS OF INDUSTRIAL ENGINEERING PRINCIPLES: A SOUTH AFRICA CASE
K. Ramdass, K. Mokgohloa and F. Nemavhola

Industrial engineering is the application of scientific principles in the design, development, improvement, implementation and maintenance of integrated systems of men, materials, machines and money for process optimization. It extracts expert knowledge and skills from physical sciences and mathematics infused with the principles of engineering analysis methods to maximize system utilization. South Africa remains constrained by its low growth potential. Slow private investment growth and weak integration into global value chains prevent the country from reaping the new economic opportunities emerging around the globe, and from catching up with living standards in peer economies. South Africa needs to build on its comparative advantages, that of an industrially skilled economy, to develop new domestic and international markets through higher productivity and innovation. Industrial engineering as a practice is central in improving productivity and cultivating innovation. As a result, the University of South Africa is in an advantageous position due to its reach, reputation and flexibility to disseminate the qualification in Industrial Engineering that will positively impact on the South African economy. However, the enrolment figures in Industrial Engineering are disappointing compared to other engineering disciplines. The research aimed to determine awareness and understanding of Industrial Engineering as a field among students in order to understand the factors that might be responsible for the low enrolment, throughput and graduation rates using quantitative analysis. In addition, the curriculum of the current programme was evaluated to determine its relevance and its adaption to ever-changing material conditions.

Prof Ramdass has worked as a work-study officer, industrial engineer, production/operations manager and skills development facilitator in the clothing, electronics, and textile industries between 1981 and 1999. He joined the academic profession in 1999 as a lecturer with Technikon South Africa. He later moved to UNISA’S Department of Business Management in 2006 lecturing in operations management. He is currently Associate Professor in the Department of Mechanical and Industrial Engineering based at Unisa, Florida Campus. He has a passion for quality and firmly believes that the application of quality management methodologies will highlight deficiencies and instigate the implementation of improvement strategies. He has applied continuous improvement methodologies from an industrial engineering, quality
and operations management perspective. He is a process, performance and operations specialist with a driving passion for improving production, quality and competitiveness. He has authored and presented approximately 50 journal and conference papers both nationally and internationally and is a peer reviewer for numerous publications. He achieved Fellow membership status at SAIE and is a member of PICMET and IEEE. He registered as Pr Tech Eng at ECSA and is appointed as a member of the Code of Practice Steering at ECSA.

4311 FACTORS THAT INFLUENCE THE THROUGHPUT OF ENGINEERING STUDENTS

P.J. Joubert and K.R. van der Merwe

The current throughput rate of engineering students is of significant concern, especially in light of the current financial pressure on universities. On the scarce skills list of South Africa, it highlights the importance of this problem that South Africa is facing, five engineering disciplines are in the top 10 scarce skills in South Africa. It is therefore important for universities to understand the factors that influence the throughput rate of engineering students, particularly those that the universities have control over. The purpose of this study is to investigate and identify the factors that influence the throughput of engineering students at Nelson Mandela University. Focus is placed on those factors deemed to be under the control of the university. The quantitative research methodology was identified at the start of this study as being the most appropriate with eight variables identified for the purpose of this study. The Cronbach alpha coefficient for all the variables was 0.7 or more, meaning that all the variables had an acceptable Cronbach’s alpha coefficient. With the current trends in new technology that are constantly introduced to the public at large, it is clear from the respondents’ points of view that technology could play a huge role in class in the future. Based on the empirical findings, four of the variables indicated a positive influence on the throughput rate of engineering students. The remaining four variables either showed a slightly positive influence or close to no influence, translating into no significant influence from them.

Cobus Joubert is a Lecturer in the Department of Industrial Engineering at Nelson Mandela University. Prior to joining academia, Cobus was a practising Industrial Engineer in the automotive industry for at least fifteen years. Cobus completed a Bachelor in Technology: Industrial Engineering after which he graduated with a Master in Business Administration (MBA). Cobus’s MBA treatise is titled: “Factors that influence the throughput of engineering students at Nelson Mandela University” and is evident in his research interest in engineering education and the use of technology therein. He is registered with the Engineering Council of South Africa as a Professional Technologist. Cobus will present his first paper at the SAIEnenexxx Conference.

4316 CREATING LEARNING COMMUNITIES FOR FEMALE ENGINEERING STUDENTS THROUGH MENTORING

A. Lourens, R. Plaatjes and B. Connelly

South Africa faces a shortage of engineering skills and particularly a shortage of female engineers. Often students entering engineering programmes do so from positions of inequality in terms of schooling, finances and other resources. Along with these challenges, academia is also grappling with calls for decolonisation of the curriculum and humanising the pedagogy, while developing interventions to support, develop and retain engineering students. As a result, a Women Engineering Leadership Association (WELA) was established at a South African university as a learning community, and strategies and interventions were developed in the form of co-curricular interventions to support female engineering students and practicing engineers. The aim of this research is to investigate the potential benefits of establishing learning communities to assist in the development and retention of students within the context of the challenges facing South African universities currently. Accordingly, this research discusses the characteristics and benefits of developing learning communities and reports on data obtained from a survey conducted with student mentors who were members of WELA. The results of the survey indicated that learning communities could lead to more motivated female engineering students, increased life-skills, greater social tolerance and appreciation of diversity as well as increased personal and interpersonal growth. In addition, increased academic effort and a greater sense of self-efficacy were reported. It is proposed that the establishment of a learning community can benefit students from all disciplines in the institutional quest to support, develop and retain both male and female engineering students.

Dr Ruth Connelly currently drives the learning development component of Student Counselling that seeks to enable students to function optimally. She works closely with the Engineering faculty in their intentional endeavours to support students effectively to release their full potential. Her interest in neuroplasticity, learning styles, multiple intelligence and related interventions and concepts continues to grow as she witnesses significant positive changes in the students. Ruth
is a co-creator of the computer-based Learning Enhancement Checklist (LEC). Through the use of the LEC, faculties and departments have been able to profile student needs and this has enabled informed student-centred interventions that promote student success and sustained attitudinal and behavioural change. Ruth started her career as a high school teacher, then worked as a counselling psychologist in a special school before entering Higher Education eighteen years ago.

My name is Ronelle Plaatjes. I am an Academic Developer and has been a part of the Higher Education body since 1997. I am passionate about the student success and curriculum transformation agenda in Higher Education, especially post #FeesMustFall. My life philosophy allows me to continuously immerse myself in making a difference. I love being part of transforming minds and lives around critical teaching and learning issues. I strive to be transformative in my actions: purpose driven and value-laden. Student success is about people, dreams, goals and aspirations! Through seeking interconnectivity through meaningful encounters is giving expression to one of the core philosophical values in Africa – UBUNTU. I am drawn to people and their stories. I believe stories shape spaces!

Session G1
Six Sigma and quality

4183 AN APPLICATION OF THE CONTROL CHART AND FISHBONE DIAGRAM FOR MINIMIZING DEFECTS IN SAND CASTING PROCESS
C. Sithole, K. Nyembwe and P. Olubambi

The sand casting process is widely used in most foundries in South Africa (SA) for the production of large and small castings. The sand casting process involves pattern making, moulding, metal pouring, shake out and fettling. The quality of the produced casting depends on the quality of the sand used during the casting process. This means that sand control must be put in place to monitor and control the properties of the casting sand. The Sand testing process is traditionally employed in the foundry industry as a quality control method for sand casting process essential for the green sand system. The primary aim of sand testing is to check the regularity of the ready to mould sand and the properties of green sand to control defects in the production process. The purpose of this study is to explore the benefits and application of the control chart and fishbone diagram in the sand casting process to decrease the amount of casting defects. Sand casting data was obtained from a local sand casting foundry, the data included casting defects and sand properties. The control chart was used to study and measure the amount of variation in sand casting properties due to the observed casting defects in the foundry. The fishbone was then used to find out the sources of variation that lead to casting defects. This paper presents the analysis of variation in sand properties using the control chart to explain the observed casting defects and the sources of both variation and defects using the fishbone diagram. Control charts and fishbone diagram could contribute an alternative reality in sand control in the foundry industry.

Cindy is a graduate from the Department of Metallurgy at the University of Johannesburg. Recently completed her Masters in Engineering Metallurgy focusing on the application of Six Sigma technique to metal casting. Her research was conducted in an automotive foundry and was centred on defect reduction using the Six Sigma DMAIC methodology. Cindy has a strong interest in metal manufacturing process optimization using quality tools.

4198 EVALUATING THE USE OF SIX SIGMA IN THE IMPLEMENTATION OF IMPROVEMENT PROJECTS IN A FREIGHT RAIL COMPANY
G. Muyengwa and A. Baloyi

This paper evaluates how a company a freight rail company, (known as Company A in this study), has used the Six Sigma methodology to improve operational processes and reduce costs. A mixed method was used to gather data. A questionnaire with 22 Six Sigma critical success factors (CSF) was used. Interviews were conducted with project sponsors and project executing team members. Four comprehensive improvement projects that were done in this company were analyzed. Factor 1 accounted for 20.975 percent of data variation and had the following CSFs: problem solving, right tools, cross functional teams, CTQ special processes, right culture, information and communication, appropriate metrics. Factor 2 had the following CSFs: Management commitment, Project leadership, Six Sigma and strategy, Innovation and design, infrastructure and resources, motivating the workforce-this factor accounted for 19.287 percent of the total variation. The findings of this paper contribute to the Six Sigma literature by exploring the
CSF that are used to improve operational processes and reduction of costs. However the results of this study cannot be generalized because only one company was evaluated.

Mr Amukelani Baloyi studied Industrial Engineering at the University of Johannesburg. He holds a masters degree in Engineering Management. He is a lecturer, since 2010, in the Department of Mechanical and Industrial Engineering Technology at University of Johannesburg. He is registered for his PhD studies in Engineering Education. His PhD research work is looking into the application of Total Quality Management in Higher Institutions of learning. His research interest are in TQM, Engineering Education, Six Sigma and productivity improvement projects.

4267 THE USE OF DMAIC SIX-SIGMA METHODOLOGY FOR DISPUTES RESOLUTION IN A PACKAGING COMPANY

J-C.M. Baraka, M. Dewa and R. Singh

Industrial engineering plays a vital role in production improvement and the optimization of systems. With the growing impact of globalization, championing the production of quality goods and systems is key to survival. Another notable effect of globalization is the rise of work-based conflict in recent years. This study intends to use DMAIC six-sigma in resolving these work-related conflicts. After the quality assurance staff raised complaints in regard to work overload and salary increases, management decided to use work study to evaluate these claims. The results of the case study highlighted a number of challenges including breakdown in communication between hierarchies and the lack of quality assurance standardized work processes. The study recommends the restructuring of work tasks and systems in order to optimize workers’ productivity and improve motivation.

Mr Mendon Dewa is a lecturer in the Department of Industrial Engineering at the Durban University of Technology. His research areas of focus include optimisation techniques and energy efficiency.

Session G2
Influencing policy

4161 ADAPTING ACCOUNTING BEST PRACTISES FOR USE IN ENERGY-RELATED REPORTING

J. Booysen

Corporate energy- and environmental reporting requirements are constantly evolving in a drive to clearly represent the realities associated with industrial activities. This continued drive creates a dynamically changing landscape full of uncertainties. Financial accounting and reporting experienced similar challenges which eventually lead to the development of universally accepted concepts and conventions. This allowed for the effective review and reporting of the results to a wider stakeholder audience. This paper presents a framework that can be used to adapt accounting best practices for application in the engineering- and energy reporting domain. The framework follows an iterative approach to develop and refine possible analogies. The developed analogies are applied to a pool of nearly 100 energy-related research publications to test their relevance. The results highlight the need for integration between multiple disciplines and provide a relation between well-established financial principles as an alternative solution to real engineering challenges.

Ms. J. Booysen holds a M.Eng. in Mechanical Engineering as well as a B.Eng. in Chemical Engineering from the North-West University. She is currently enrolled for a PhD degree at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

4221 INDUSTRIAL ENGINEERING TECHNIQUES AND SERVICE DELIVERY IN MUNICIPALITIES

H. Steenkamp

Industrial engineering techniques have been applied in the private sector in manufacturing and service industries with success. Industrial engineering techniques have also been applied in the public sector. This study aimed to investigate the application of industrial engineering techniques to optimise municipal services. In South Africa poor service delivery has been a continuous problem for inhabitants for more than a decade. Municipalities are under pressure to improve service delivery and reduce costs. Researchers approached the City of Johannesburg and the city of Ekurhuleni for access to their data pertaining to the study. The current state, of reaction times to complaints logged, were investigated at Ekurhuleni. At the City of Johannesburg a survey was completed to determine
satisfaction of clients with general service delivery of the municipality. Industrial engineering tools were used in the analyses of the current state and it was established that industrial engineering techniques could be used to improve municipalities.

Lecturer at the University of Johannesburg in the Mechanical and Industrial Engineering Technology department. Currently busy with a D.Ing at the University of Johannesburg researching the use of industrial engineering techniques to improve retention of engineering students. Holds a M.Ing in Industrial Engineering from Pretoria University and a B.Ing in Industrial Engineering from Stellenbosch University. Specific interest are in engineering education and lean manufacturing.

4340  
SYSTEMATIC LITERATURE REVIEW OF SUSTAINABLE URBAN PLANNING CHALLENGES ASSOCIATED WITH DEVELOPING COUNTRIES  
A. Jooste

The purpose of this study is to uncover the most prominent challenges that urban planners face when tackling sustainable practices in developing countries. The time frame was set to after the 2012 Rio +20 global summit. Therefore, only articles that were produced from Jan 1st, 2013 till March 31st, 2019 were included as they would have adhered to the contributions and protocols set forth at the largest UN Earth summit conference. A systematic literature review gathers all the recommended research required to conduct a qualitative assessment of a particular subject matter. In this study, a review on the sustainable urban planning challenges is conducted. Then, the challenges are grouped together into topics that align with the theme of the type of challenge. Finally, the challenges are tallied up to identify the most well known and disruptive challenges that restrict urban planners in developing countries.

Industrial engineering Master student at Stellenbosch University. Fields of research interest include Sustainable systems and Engineering management.

4185  
A CONTROL PROCESSES TO SUSTAIN ELECTRICITY COST SAVINGS ON A MINE WATER RETICULATION SYSTEM IN SPITE OF CRITICAL COMPONENT FAILURES  
B. Pascoe, J.F. van Rensburg, J.H. van Laar

Equipment failure is common in mining. Failures may create unsafe scenarios and result in optimised control strategies being abandoned. This may lead to loss of savings due to extended repair periods. A technology management process was thus developed to mitigate this problem by using actual data to develop strategies to ensure safe future underground conditions when critical component failures occur. This also provides an alternative process to improve real life scenarios while achieving electricity cost savings. The selected strategy, for a given scenario, will firstly avoid dangerous conditions and, secondly, obtain a portion of the electricity cost savings, which would otherwise be lost due to critical component failures. This process was implemented on a gold mine in South Africa, which led to an annual electricity cost savings of approximately R3.8 million. These savings were possible without incurring dangerous scenarios and without capital expenditure required for implementation.

Dr. B. Pascoe holds a PhD in Mechanical Engineering from the North-West University, along with an M.Eng in Mechanical engineering. He is currently enrolled as a postdoctoral fellow at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

4239  
INTEGRATION OF CATENARY TRACER TO ASSES TRAIN CATENARY OF HIGH SPEED TRAINS  
M. Lelala-Mnguni and D.V.V. Kallon

This study focusses on integrating a catenary tracer system that assesses the condition of the catenary wire (overhead wire) at Gibela rail, in Johannesburg, South Africa. The catenary tracer device measures the wear of the overhead contact wire and provides continuous monitoring of the catenary. Integration of this system is shown to
reduce the overhead system maintenance costs and prevents unforeseen service interruptions. At present a huge labor force is employed to continuously inspect every meter of the high voltage 3 kV contact wire throughout the electrified system. The data of the catenary wire is collected by a laser scanner mounted in a housing bracket on the roof of the train. At the same time the data acquisition box acquires the speed from the speed sensors and the vibration signals from the accelerometer sensors mounted on the bogies. The system is designed to continuously collect this data, synchronize it all through computation and store it until it can be downloaded for routinization. The collected raw data is analyzed and loaded to the depot server and compared to a reference to determine if maintenance on the catenary wire is required. The analysis of the collected data is presented herein. Mpho

Lelala Mnguni, currently work as a Mechanical lead Engineer - Fittings and Interiors at Gibela Rail since November 2016. Matriculated in 2006 from Residensia Secondary School in the Vaal, Graduated from Vaal University of Technology, N.Diploma, Mechanical Eng In 2012. And B-Tech Mechanical Eng in 2014. Worked as a learner technician at Knorr-Bremse SA from 2010 to 2011, and Junior draftsman from 2012 to 2013 in the Automotive department. And then was promoted to Draftsman in 2013 to 2014. And then worked in the rail department at Knorr-Bremse in 2015 as Mechanical design Engineer.

4252 COMPARISON AND CORRELATION OF NANO-INDENTATION HARDNESS TO MICROHARDNESS IN ALLOYS
S. Chikumba and V.V. Rao
Measurement of mechanical properties is a vital part of quality control of various product components. It ensures they conform to set material design specifications. One such property often measured is hardness. In today's technological world where miniaturisation of components is becoming common in electronic and other industrial products measurement of properties of hardness and prediction of mechanical behaviour is demanded not only on a micro scale but nano scale. The important question is whether micro hardness can predict nano hardness in materials. In this paper an attempt is made to compare microhardness to nano hardness values in alloys.

Senior Lecturer in industrial engineering, UNISA

4173 REDUCING PARCEL PROCESSING BY MEANS OF THE LEAN METHODOLOGY
M. Roopa and R. Coetzee
The parcel industry holds potential in improving customer service levels and is tasked with reacting to increasing e-commerce platforms nationwide. The aim of this study is therefore to improve the processing times of a local courier department using a lean approach and consequently improving their customer service delivery levels. The DMADV methodology was followed, utilising Therblig classifiers, value stream mapping, root cause analysis, a Pareto chart, an Ishikawa diagram and a V-model. The investigation revealed that the long processing times were owed to high levels of transcribing, leading to the implementation of an electronic barcode system. The electronic system was successful in reducing the 12 Therblig classifiers by 33% on average. However, the overall lead times were not reduced significantly, thus emphasising the challenges associated with implementing new technology without the parallel human skills development, which is pivotal for ensuring the success of any improvement initiative.

Meelan is a Lecturer in the School of Industrial Engineering at the North-West University. His research interests pursue a quantitative approach within Operations and Supply Chain Management and investigate the use of Lean and Green principles.

4321 INVESTIGATING HUMAN BEHAVIOUR IN QUEUES
J.H. Bührmann and R. Chiwawa
Queueing theory is the study of waiting, specifically how any type of queuing structure will perform given arrival and service rates. Mathematics and analytical methods have been used but often the human side is neglected. This study focused on studying the behavioural impact of queues. Two experiments were conducted to test human behaviour in
queues; one to test the impact on both the servers and clients in terms of customer’s queue length, waiting time and cashier service time, the other to test perceived waiting times by customers.

Dr. Joke Bührmann is a senior lecturer in Industrial Engineering at the University of the Witwatersrand specialising in Operations Research and Machine Learning. She has industry experience in areas including business analytics, data and optimisation analysis, business intelligence and application development.

Session H2

Saving energy

4167  STRUCTURING UNCERTAINTY MANAGEMENT FOR ENERGY SAVINGS CALCULATIONS

K.A. Johnson, W. Hamer and J.C. Vosloo

South Africa has committed to reducing its greenhouse gas (GHG) emissions. A key strategy to minimise this GHG intensity involves utilising incentivised energy efficiency initiatives. In South Africa one of these energy efficiency incentives is Section 12L of the Income Tax Act. The section 12L tax incentive rewards claimants 95c/kWh for verified energy efficiency savings (EES) linked to reduction of GHG emissions. This verification is done using the SANS 50010 standard. The SANS 50010 standard requires management and quantification of the uncertainty associated with reported savings. Accurate quantification of EES is therefore critical and highlights the need for uncertainty management to ensure accurate and fair results. Though uncertainty quantification and management (Q&M) methods are already available, the correct and consistent application of relevant methods for specific uncertainty contributors is important. In this study, a solution in the form of an uncertainty Q&M flowchart was developed for quantifying and managing EES uncertainties. This tool incorporates a five-step approach towards EES quantification and was applied to three industrial energy efficiency case studies. It was found that uncertainty levels can range between 2% and 18% due to varying uncertainty contributors. This highlighted the need for a structured approach to pro-actively identify, quantify and manage uncertainty contributors.

Dr Waldt Hamer is a holds a PhD in Mechanical Engineering from the North-West University. He is currently a post-doctoral student and mentor at the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

4307  DESIGN AND MANUFACTURE OF SOLAR POWERED GRASS TRIMMER

M. Pita and P.B. Sob

Common grass-cutter machines are operated by fuel and electrical energy, which are expensive, and need high maintenance. To keep environment clean and reduce use of fuel a solar powered grass trimmer has been designed in this research work. The purpose of this study is to design and fabricate a solar-powered grass trimmer which is affordable, easy to operate and environment friendly. The grass trimmer uses a 12V, 100AH battery to power a 12V DC motor of 180W. A solar panel 1000V system voltage is used to charge the battery. A solar charge controller of 20A is used to control the energy into the battery. The machine uses sheet metal blade to cut the grass. It can run for almost two hours when fully charged and there is no sun. It is easy to tell if the battery is fully charged or flat.

Mothibeli Pita is currently pursuing his Doctorate degree in Mechanical Engineering with University of Johannesburg (UJ). He has more than 3 years’ experience in lecturing. He completed his MPHIL degree in Engineering Management in 2015 from University of Johannesburg. He has successfully completed his undergraduate studies in 2006. He holds a Bachelor of Engineering in Mechanical Engineering from Central university of Technology (CUT) in 2007. His primary research areas are material science, design and manufacturing and maintenance engineering. He has knowledge of material testing, designing and manufacturing as well as maintenance management from his previous works which involve hospital maintenance management, tensile, hardness, fatigue, impact, bending and compression tests. As in design and manufacturing of two roller rolling machine and solar powered grass cutter which he successful build.

4314  EFFECT OF DISCHARGE DIAMETER ON CENTRIFUGAL PUMP PERFORMANCE

M.E Matlakala and D.V.V Kallon

This report presents a study on the effects of the discharge diameter on the performance of the centrifugal pump. The performance of a centrifugal pump changes when one of the performance characteristics changes. The aim to
analyse what happens to the discharge pressure and the stresses experienced at the discharge area when the diameter of the discharge. For most water and other noncorrosive services, stainless steel material satisfies these criteria for the impeller and the casing of the pump. Design constraints and limitation were identified. Boundary conditions were selected. Design of the pump assembly was done on SolidWorks. Results obtained from SolidWorks were interpreted and simulated with ANSYS to determine high stress points and deformation. Graphs were displayed as the results of possible calculations. From the calculated results, it was observed that the discharge pressure, velocity, and the head increases as the discharge diameter decreases. From the simulated results it was observed that as the diameter decreases the maximum stresses experienced as the discharge area also decreases.

Company: Rand Water
Position: Mechanical Engineering Graduate
Fields of Interest: Engineering, Design, Manufacturing and Production

Session H3
Industry 4.0 Opportunities

4218 INNOVATING FOR MARKET ADOPTION IN THE FOURTH INDUSTRIAL REVOLUTION
A.P. Botha
Will market adoption of innovative products and services in the Fourth Industrial Revolution (4IR) require an alternative reality? This question is investigated in a concept paper where new product adoption patterns; alternative innovation regimes, that include intelligent machines as innovation partners with humans; disruption of the producer; the 4IR consumer and a fundamental change in business models are considered. Thought models are proposed where these four entities drive a new concept of "life-world" products where consumers innovate for their own personalisation and customisation, manufacturing plants for volume products become algorithm factories, and the linear value chain is destroyed to be replaced by the value network. This happens because the consumer becomes part of the value chain and overlaps of producer and consumer functions as we know it, merge into a new production ecosystem driven by social commerce. Innovation by the consumer takes away concerns of market adoption by the producer who may now servitize innovation support. This paper is meant to stimulate academic debate and to initiate research that will validate the thought models suggested.

Dr Anthon Botha is Managing Director of TechnoScene (Pty) Ltd, a future thinking consultancy that he founded 30 years ago and that operates in the realms of technology management, innovation management and knowledge management. He is also part time academic at the Graduate School of Technology Management at the University of Pretoria in South Africa, and Extra-ordinary Professor in the Department of Industrial Engineering at Stellenbosch University. As a trained Physicist, he enjoys working nowadays mostly in the engineering world. Anthon has published numerous research papers, contract reports, white papers and opinions on new technology and future worlds of business and living and is the author of a book: "Knowledge – living and working with it". Recent future thinking facilitation projects included: marine warfare of the future; fresh produce markets of the future; mine of the future; water quality management of the future; and an aluminium industry roadmap.

4323 THE EVOLUTION OF BUSINESS MODELS FROM SUPPLY CHAIN TO AGILE DEMAND NETWORKS THROUGH ADDITIVE MANUFACTURING
J.E.W Holm and W.H. Harmse
Disruptive technologies was the driver for each one of the first 3 industrial revolutions. These technologies shaped the evolution of the supply chain. As the customers became more demanding, business models had to adopt from a focus on supplying the customers with goods according to a forecast to a demand driven business model. The dynamics required to full fill customer demand required more dynamic thinking and agility. It was also requested that companies leave behind the linear chain thinking and participate in flexible agile networks. As with all the previous three industrial revolutions, disruptive technology also plays an important part in shaping the fourth industrial revolution. In order to survive and thrive in the fourth industrial revolution companies will have to transform their business models from a supply chain model to an agile demand network. The most disruptive technology of the fourth industrial revolution is additive manufacturing. This paper will discuss the key requirements of an agile demand network and also the role that additive manufacturing plays with the transformation from a business model based on supply chain principles to a business model based on an agile demand network that will allow companies to thrive in the future.
Henk Harmse is working at Sasol in the position of senior manager Inventory management Sasolburg Operations. He is currently busy with his PhD at NWU where his research focus on the role of additive manufacturing in transforming business models for spare part provisioning.

**AN ASSOCIATION FOR PERFORMANT BIG DATA VENTURES BY INDUSTRIAL ENGINEERS**

N. Hesse

This year’s SAIIEneXXXt logo (a dolphin) inspired a weird but wonderful association of how some Industrial Engineers (IEs) should interact with the waves of Big Data ventures. Big Data is commonly referred to as high-volume, high-velocity and high-variety of information assets that demand innovative forms of appraisal. Big Data ventures aim to enhance insight, decision making, or process automation. And as tacky as it may sound; we want to suggest that IEs should be especially performant in seeing through the most trying Big Data projects - like dolphins perform in nature and alike. When intelligence meets mindfulness an unstoppable force of trust and creativeness clicks all the salient features together. Our association also plays on the interaction of different disciplines, environments, and the ever-evolving glossary linked to Big Data. We believe this association will confirm some sentiments and stimulate some discussion in our South African Industrial Engineering community.

Ninett Hesse currently works as a Logistics Engineer at DSV. She was awarded her Professional Engineering registration from ECSA based on her rich history in Project Management. By combining her project management skills with Big Data opportunities at DSV, she believes she is demonstrating how good Industrial Engineering principles help guide people through the 4th Industrial Revolution.

**Session J1**

**Data meets knowledge**

**4168 FINDING THE FOUR QUALITIES TOWARDS INTELLIGENT INDUSTRIAL REPORTING**

L.A. Botes, W. Hamer, S. van Jaarsveld and M. Kleingeld

Internationally, innovation and technology are driving change through concepts such as “Industry 4.0”. However, due to various constraints, South Africa is lagging in this transformation. Furthermore, local industry generates large amounts of data which could contribute to a positive transformation. Data analytics, in the form of reporting, may therefore present a workable alternative to better understand the intricate nature of real-world operations. This paper identifies four qualities for the practical application of data analytics, with the aim of intelligent reporting. The four qualities are focus area, data availability, analytics and visualisation. Research with regards to each quality shows that they consist of various levels. A comprehensive literature review supports these findings. Forty studies are included which were selected through a process of relevant research criteria. A case study is presented to show how the four qualities contribute to the development of intelligent reports as an objective representation of industry performance.

Ms. L.A. Botes holds a Master’s of Engineering in Mechanical Engineering from the North-West University. She is currently enrolled for a PhD degree the North-West University’s Centre for Research and Continued Engineering Development (CRCED) in Pretoria.

**4186 SOCIAL MEDIA: A KNOWLEDGE SHARING TOOL IN ORGANISATIONS**

O.C. Kiessig and C.C. van Waveren

Knowledge management entails more than just the capturing, storing, and disseminating of knowledge. It is the actual sharing and use of knowledge that makes knowledge management a success. Social media has become an integrated part of our daily lives and with the Internet of Things we are being connected to a network of some sort at any given point in time. With the use of the mobile internet, social awareness and the availability of information, whether real or fake, is increasing. Companies need to investigate ways in which they can make use of social media platforms to share knowledge and improve the productivity and effectiveness of their employees but also address certain social media concerns. A framework, indicating key requirements for a social media knowledge sharing platform is proposed through a literature study and thereafter evaluated using a Delphi technique. The framework entails five key requirements for a social media platform to be used as a knowledge sharing tool within organisations.
The study also highlights some important personal and organisational traits needed to support the use of a social media platform as a knowledge sharing tool.

Corro van Waveren is Senior Lecturer in the Department of Engineering and Technology Management at the University of Pretoria, South Africa. He holds the degrees B.Eng. and M.Eng. in Mechanical Engineering as well as a M.Eng. in Engineering Management. He started of his career as a full-time engineer, and later as project manager and assistant manager in a private engineering company in South Africa specialising in the field of structural mechanics and servohydraulics. He currently lectures on post graduate programmes as well as courses for industry in the field of project management, quality management and reliability centred maintenance and his current research mainly focuses on knowledge management within project environments.

4254 THE IMPACT OF DESIGN, MANUFACTURING AND END OF LIFE LOGISTICS OF CONSUMER PRODUCTS
S. Chikumba
In many urban environment the disposal of consumer products its presenting a challenge to municipal authorities and communities. Consumers purchasing products often do not consider the impact of the products on the environment. In this paper the impact of end of life logistics of products on urban environments is explored and how product design, manufacture, use and disposal of various products is impacting urban environments.

4305 SELECTION OF A COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM FOR MECHANICAL AND INDUSTRIAL LAB EQUIPMENT OF UNISA
M. Pita and K. Ramdass
The research on which this article is based, sought a suitable computerized maintenance management system (CMMS) for use in the Mechanical and Industrial Engineering laboratories and workshop at the University of South Africa. The university plans to implement such a computerized maintenance management system, to keep track of past repairs, schedule future maintenance, and maintain a ready list of vendors or sources of parts. Currently, the department does not have a maintenance strategy or equipment history. The price of a product is an important factor when selecting a CMMS program. The recommended software will not place to great a stress on the departmental budget, is user friendly and can be used by two to five users.

Mothibeli Pita is currently pursuing his Doctorate degree in Mechanical Engineering with University of Johannesburg (UJ). He has more than 3 years’ experience in lecturing. He completed his MPHIL degree in Engineering Management in 2015 from University of Johannesburg. He has successfully completed his undergraduate studies in 2006. He holds a Bachelor of Engineering in Mechanical Engineering from Central university of Technology (CUT) in 2007. His primary research areas are material science, design and manufacturing and maintenance engineering. He has knowledge of material testing, designing and manufacturing as well as maintenance management from his previous works which involve hospital maintenance management, tensile, hardness, fatigue, impact, bending and compression tests. As in design and manufacturing of two roller rolling machine and solar powered grass cutter which he successful build.

4174 DEVELOPMENT OF AN INTEGRATED PROJECT LIFE CYCLE MODEL ON GOLD MINING COMPRESSED AIR SYSTEMS
F. Jansen van Rensburg, J. van Laar and J. van Rensburg
Many South African gold mines are marginal or becoming non-profitable, due to electrical cost increases and unstable commodity prices. Compressed air systems are big contributors to operational costs on ultra-deep level gold mines. Legacy compressed air systems are inefficient <15% of the compressed air generated, effectively used for mining. There is a need to implement optimisation projects to increase the energy efficiency of systems. Previous implementations have shown that capital intensive projects often fail due to incorrect processes followed during the project life cycle. An integrated project life cycle model was developed from literature, integrated simulations and
past knowledge. The model was applied to supply and demand side compressed air projects on an ultra-deep level gold mine. The mentioned projects were designed, implemented and managed successfully with the new model and a sustainable financial impact of more than R10 million p.a. was achieved while also improving service delivery.

Mr. Jansen van Rensburg, FG, holds a Master’s degree in Mechanical engineering from the North-West University. He is currently enrolled in his PhD studies at the North-West University’s Center for Research and Continued Engineering Development (CRCED) in Pretoria.

4282  INFLUENCE OF IMPELLER BLADE COUNT ON THE PERFORMANCE CENTRIFUGAL PUMPS
M. E Matlakala and D.V.V Kallon

The objective of the project report was to design an impeller with a correct number of the blades that will be able to carry enough capacity of water through discharge of the pump casing. The selection of the suitable material for the impeller was taken into consideration because the number of blades of the impeller contribute to the amount of material required to do the impeller. Three impellers with different number of blades were designed to satisfy the aim of the project. The research was done on the different impellers that are currently functional in the industry and also look into the materials that these impellers work best from when considering all the properties that might damage the impeller and also cause decay to the designs. The calculations and simulation results obtained was observed that as the number of blades increases on the impeller the performance of the pump decreases. For material selection, Bronze is found to be a suitable material that is used to manufacture impeller and it also helps protects the impeller from corrosion or any sorts of decorations.

Company: Rand Water
Position: Mechanical Engineering Graduate
Fields of Interest: Engineering, Design, Manufacturing and Production

Session K1
Intelligent decision making

4175  A FRAMEWORK FOR A DECISION SUPPORT TOOL IN AN AGILE AGRICULTURAL ENVIRONMENT
J. Wium, J. van Eeden and J. Bekker

Supply planning in table grape production is difficult due to long lead times from planting to production with variable yields. Market agility for producers is important due to market volatility while diversified income streams and markets lower a producer’s risk. Strategic managers need to ensure market demand match the harvest available through planning cultivar diversity. Tactical managers need to realise the strategy by carefully scheduling harvest and labour plans. These plans are created manually following a cumbersome and sub-optimal process. Operations managers need to implement this plan, however face day-to-day challenges not accounted for in the tactical plan. Agile decision making at tactical and operational levels is needed to work around obstacles in a complex decision space. In this work the characteristics of a decision support system (DSS) needed for tactical and operational decisions are explored and a framework for creating such a DSS based on current literature is provided. A real alternative in the South African fresh produce sector is addressed which requires everyday industrial engineering solutions such as systems design, optimisation, simulation and scheduling.

Jolene works as a business analyst in agriculture and public health. She is co-founder of a business intelligence consultancy, Sumit Insights, and have been building business intelligence solutions for the past six years. She is currently pursuing a PhD in Industrial Engineering at Stellenbosch University where her research explores everyday industrial engineering tools to solve real world problems in a highly perishable fresh produce environment.

4217  DEVELOPMENT OF A FRAMEWORK FOR APPLICATION IN THE SELECTION OF AN APPROPRIATE PRODUCTIVITY IMPROVEMENT TECHNIQUE
N. Mosia

When conducting productivity improvement projects, engineers are confronted with a dilemma regarding the choice of an appropriate tool or technique that will exploit a particular productivity prospect maximally. There are numerous tools and techniques that can be applied in various situations but there is no methodology that can be used to select
the best method that will yield the most output, in a particular setting. This research paper presents a comprehensive example that illustrates a method for selecting the best productivity improvement technique, that will yield the best possible results. This research paper presents an example that illustrates how to choose productivity improvement tools and techniques that will yield the best possible results when applied in a particular setting. A comparison of the results achieved with and without the process is support for the application of the methodology. A qualitative research approach is adopted to explain and explore various methods applied.

Ngaka Mosia is a Junior Lecturer in the department of Mechanical and Industrial Engineering, in the school of Engineering and a College of Science, Engineering and Technology at the University of South Africa (Unisa), in Gauteng, South Africa. He holds a BSc (Hons) in Applied Science from the University of Pretoria (UP), a BTech in Industrial Engineering from University of Johannesburg (UJ) and post graduate certificate in Distance education from the University of Maryland University College (UMUC). He holds the following awards, honors and academic distinctions: Special Guest (IEOM Conference), Outstanding Teaching Excellence Award, Excellence in Innovation Tuition (Unisa). He has a research output of 3.5 in the past five years. His research interests includes technology mediated teaching and learning and Productivity improvement through mechanization, Humanization for productivity improvement. He has been part of Unisa’s academic staff since 2013. He is a member of SAIE & PICTMET and Nadeosa & DEASA. As part of community service, he is involved in a Lean Healthcare project within a local healthcare facility and he is part of a Robotics outreach projects to local schools. His interests include Water sport, Chess and Robotics and designing miniature structures.

QUALITY RESEARCH MANAGEMENT IMPROVES DESIGN RESEARCH EFFECTIVENESS

J.E.W. Holm and G.P.R. van der Merwe

Design research projects are often more complex than initially perceived for reasons such as a requirement for novelty, creativity inherent to the design process, and limited experience of novice researchers. In addition, requirements from institutions and external, funding stakeholders must be addressed to meet expectation. As a result, a framework was needed to support the research effort in the form of quality research management. The main focus of this framework is on expectation and requirements management to ensure alignment between stakeholders. To this end, the wealth of engineering management methods and techniques was consulted to define a quality research management framework that provides review baselines, requirements traceability and a general process model. The framework is further based on the well-known House of Quality principle that uses matrices to allocate and trace requirements. A series of matrices was developed, with a final research validation matrix resulting from the combination of traceability matrices. This matrix allows allocation of research challenges to a need, concept solutions to research challenges, and specific research solutions to concept solutions. In addition, information sources are allocated to challenges and solutions to verify authenticity. From the research validation matrix it is possible to clearly visualize a summary of the research project with a researcher’s own contribution clearly highlighted to simplify review. Additional benefits resulted in the form of improved communication and alignment. Overall, the ability to visualize progress, trace requirements and allow for verification and validation illustrate the value of quality research management.

Johann Holm is an Electronic and Computer engineer with postgraduate qualifications in pattern recognition, numerical optimization and machine learning. He is a professional engineer and member of the IEEE and INCOSE. Johann is employed by the North-West University where he presents a course on Engineering Management. He is experienced in engineering and technology management with interest in Systems Engineering, specifically applied to business process engineering and optimization. His specific focus is on operational modelling and R&D in an IoT environment.

A DECISION MODEL TO SUPPORT THEATRE ALLOCATION FOR NON-ELECTIVE PATIENTS IN A PRIVATE HOSPITAL

C. du Plessis, M. van Zyl and H. Darwish

Operating theatre planning is a very complex process due to the involvement of many stakeholders and the influence of variability on output performance measures such as financial indicators, waiting times, throughput and utilisation. In addition to this, the unforeseen arrival of patients in need of non-elective surgeries may cause a thoroughly
planned operating theatre schedule to change with each arrival. This may have an influence on efficiency, utilisation and waiting time between surgeries. The purpose of the study is to offer a solution to this problem by determining which allocation policy for patients in need of non-elective surgery will be best suited for this private hospital. The policy should ensure a balance between scheduling patients for elective surgery and responding to the arrival of patients in need of non-elective surgery and should contribute towards the utilisation of the operating theatres.

Lecturer - NWU - School of Industrial Engineering

4195 HEALTH CARE DATA MANAGEMENT IN DEVELOPING COUNTRIES: A SYSTEMATIC REVIEW
L. van der Merwe, W. Bam and I. de Kock

There are many healthcare data management challenges in developing countries. These challenges have a major effect on the quality of healthcare service delivery. Therefore, it is very important to determine the most prominent healthcare data management challenges in developing countries to be able to address the right challenges effectively and efficiently. This paper discusses some of the prevalent healthcare data management challenges in developing countries through a systematic literature review. Scopus was used to retrieve literature on these healthcare data management challenges. The initial search was done on 16 April 2019 and yielded a total of 162 articles. The search terms included “data processing”, “data management”, “data administration”, “data handling”, “data control”, “information management”, “healthcare”, “Health care”, “south africa***”, “developing country***”, “challenge***”, “problem***” and “issue***”. After the exclusion process the eventual number of articles was 62. The structured literature review was used to scope all the different healthcare challenges. The challenges were categorized into different data management categories and data management challenges subcategories using Excel. The most prevalent healthcare data management challenges were identified from literature using the Excel scope of challenges. The literature review methodology is explained, then the study selection and characteristics of the results are described, followed by the analysis and discussion of the scope of healthcare data management challenges.

Laubscher is currently a first year Industrial Engineering Masters candidate at Stellenbosch University. He finished his Industrial Engineering undergrad last year and is now doing his research under the Industrial Engineering Sustainable Systems department of Stellenbosch University. His research is focused specifically on sustainability in health care systems.

4247 MEDICINES STOCK VISIBILITY SUPPORT TOOL USING DEMAND-DRIVEN SUPPLY CHAIN MANAGEMENT PRINCIPLES
J. Milligan, C. N. Ngongoni, S.S. Grobbelaar and S. Hlongwane

Healthcare supply chain management is of paramount importance when it comes to the provision of timely and quality healthcare services. However, the prevalence of drug stockouts in healthcare institutions across South Africa ascertains that there is a need for concrete, collaborative and proactive frameworks and tools to guide performance improvement and enhance service delivery. This paper outlines the conceptualisation of a drug stock visibility support tool that utilizes Demand-Driven Supply Chain Management (DDSCM) principles. The design process for the medicine stock visibility support tool is based on a conceptual framework that unifies the DDSCM concepts and aspects of standardised logistics management indicators in the public sector. The design process is informed by the Technology Life Cycle (TLC) approach and Frazelle’s Logistics Scoreboard Framework. The proposed tool is intended as a step towards promoting collaboration for the implementation of DDSCM between Private and Public healthcare supply chain actors in South Africa.

My name is Sanelisiwe Hlongwane. I was born in Pietermaritzburg, KwaZulu-Natal to a mother from Mphophomeni and a father from Mphendle. As a product of Pietermaritzburg public schools, I became the first generation in my family to attend Stellenbosch University in 2015, which has been the fuel that has driven me to get to where I am today. I am currently a Masters candidate at Stellenbosch University, where I’m completing my thesis which focuses on the improvement of public healthcare.
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