

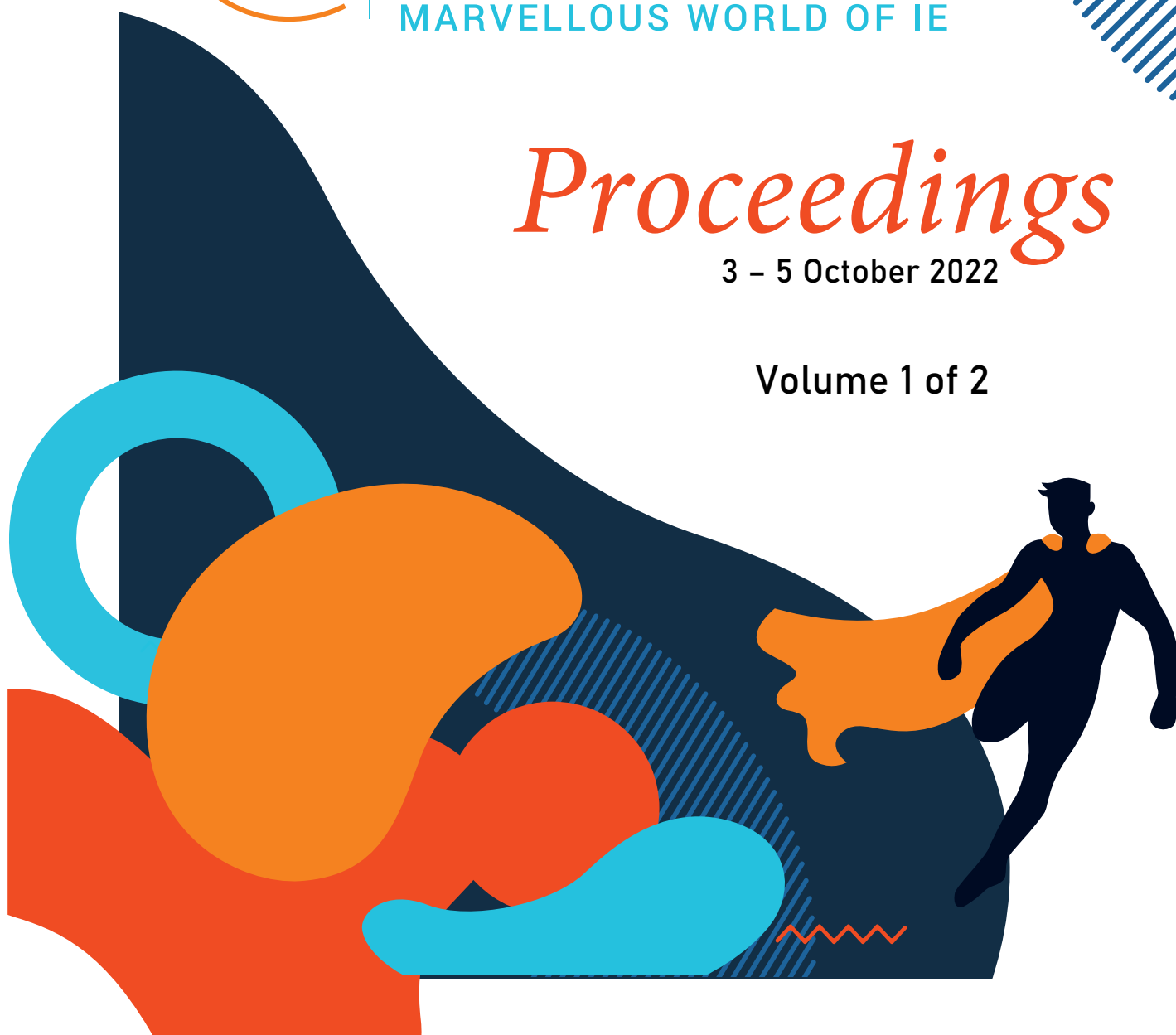


SAIIE33
THE INDUSTRIALS
MARVELLOUS WORLD OF IE

Proceedings

3 – 5 October 2022

Volume 1 of 2





SAIIE33
THE INDUSTRIALS
MARVELLOUS WORLD OF IE



Proceedings

OF THE 33RD ANNUAL
SOUTHERN AFRICAN INSTITUTE FOR INDUSTRIAL
ENGINEERING CONFERENCE

3 – 5 October 2022
The Capital, Zimbabwe, KwaZulu-Natal, South Africa

ISSN: 2308-8265
ECSA CPD Nr: SAIIE / CPD / 1 / 8-22

Editor:
Prof Teresa Hattingh
North-West University, South Africa

Contents available on the conference website: [www.saiie.co.za/
publications](http://www.saiie.co.za/publications)

Published by: Southern African Institute for Industrial
Engineering (SAIIE)
www.saiie.co.za



**“LIFE DOESN'T GIVE
US PURPOSE. WE GIVE
LIFE PURPOSE.”**
(THE FLASH)

SAIIE Copyright © 2022



Content



Ref*	Paper Title & Authors	Page
1	IMPLEMENTATION OF A ROBOTIC ARM FOR PALLET LOADING AND UNLOADING IN THE BEVERAGE INDUSTRY M. T. Mpofo, G. P. Chirinda and S. Matope	29
7	THE INFLUENCE OF ORGANISATIONAL CULTURE ON TACIT KNOWLEDGE SHARING BEHAVIOUR: THE CASE OF ANGLO AMERICAN COAL V. Ntshabele and T.J. Bond-Barnard	44
8	AN EXPLORATION OF TOTAL QUALITY MANAGEMENT ON TRANSPORTATION SERVICES J. Baloyi, N. Sukdeo, K. Ramdass and I. Ohiomah	60
16	DESIGN OF EXPERIMENTS PROCEDURE FOR EVALUATING THE FORMABILITY OF SHEET METALS COMPONENTS IN FORMING PROCESSES B. Sarema, S. Matope and A. Sterzing	73
18	THE APPLICATION OF LEAN SIX SIGMA WITHIN THE DEVOPS CYCLES T. Hall, J.N. du Plessis, C. Schutte and J. Prinsloo	85
19	DUST AND ASH PLANT HEALTH MONITORING DATA THAT IS NOT EFFECTIVELY UTILISED TO INCREASE PLANT UPTIME S.D. Koloane, M.G. Kanakana-Katumba and R.W. Maladzhi	102
22	COMPARING CLASSICAL AND HEURISTIC OPTIMISATION TECHNIQUES THROUGH A DEEP-LEVEL MINING APPLICATION M.D. Harmse, J.H. van Laar, W.A. Pelser and C.S.L. Schutte	120
23	INVESTIGATING THE PERFORMANCE OF DIFFERENT MACHINE LEARNING ALGORITHMS FOR OPTIMAL DECISION-MAKING C. Bisset and R. Siriram	134
24	IMPLEMENTATION OF SYSTEM DYNAMICS MODELS IN INFRASTRUCTURE CONSTRUCTION PROJECTS WITHIN AN ELECTRICITY SECTOR: A LITERATURE REVIEW T. Mashamba, M.G. Kanakana-Katumba and R.W. Maladzhi	151
25	AN INVESTIGATION INTO ENERGY SAVING OPPORTUNITIES FOR PHARMACEUTICAL COMPANIES IN SOUTH AFRICA R. Olivier and H. Steenkamp	165
27	IMPLEMENTATION OF A QUALITY ASSURANCE SYSTEM FOR THE PRODUCTION OF CHROMITE SAND FOR RAPID SAND CASTING APPLICATIONS K.D. Nyembwe, N.V. Tshabalala & P.M.J. van Tonder	179

* The Reference Number is a unique paper reference that is used throughout the conference to identify the paper. This is also used as a page number prefix in the proceedings, and papers are sorted according to this number in the proceedings.



Ref	Paper Title & Authors	Page
28	AN ASSESSEMENT OF RAPID SAND CASTING THROUGH THE LENSES OF RESOURCE EFFICIENT AND CLEANER PRODUCTION (RECP) FRAMEWORK J.L. Chauke and K.D. Nyembwe	190
29	DETERMINATION OF TURNAROUND TIME FOR MAIZE RAIL WAGONS B. Mncwango and K. Ramdass	197
30	USING LEAN MANAGEMENT TO ADVANCE SUPPLY CHAIN EFFICIENCY B.T. Mncwango, K.R. Ramdass and N. Ndou	208
34	FACTORS THAT INFLUENCE THE SUCCESS OF CODING AND ROBOTICS IMPLEMENTATION IN SOUTH AFRICAN SCHOOLS J. Heyns, J. van Eeden, and G.J. van Rooyen	221
36	PROCESS IMPROVEMENT FOR THE MANUFACTURE OF EXCAVATOR BUCKET FOR A CONSTRUCTION EQUIPMENT MANUFACTURER M. Mdletshe and M. Dewa	238
37	REDUCTION OF EXCESSIVE CLAIM COSTS ASSOCIATED WITH DAMAGED CARDBOARD CARTONS IN DISTRIBUTION K.S. Biyela and M. Dewa	249
40	ANALYSIS ON THE IMPACT OF REDUCED MEAT CONSUMPTION ON THE SOUTH AFRICAN ECONOMY S. Moopen and P.N. Zincume	258
41	IDENTIFICATION OF FACTORS THAT AFFECT THE PERFORMANCE OF VIRTUAL ENGINEERING TEAMS P.N. Zincume, M.C. Erasmus and J.L. Jooste	273
46	AN INVESTIGATION TO MEASURE PRODUCTIVITY IN A SOUTH AFRICAN IT SERVICE MANAGEMENT COMPANY J.C. van Dyk and M. Roopa	286
47	AN INVESTIGATION INTO THE GAP BETWEEN BUSINESS MODELS AND SUSTAINABILITY TRANSITIONS AND THE IDENTIFICATION OF INTERMEDIARY CONCEPTS K. Venter and I. de Kock	305
53	MINIMISING ENGINEERING DELIVERY CYCLE TIME VARIABILITY ON SIMILAR PROJECTS: AN ESKOM CASE STUDY T.G. Mocheke and J.H. Wichers	329
55	A SIMULATION-BASED HORIZONTAL WATER TRANSPORT MANAGEMENT STRATEGY IN DEEP-LEVEL MINES J.A. du Preez, J.H. van Laar and J.C. Vosloo	343
56	USING ADVANCED M&V TO IDENTIFY UNPLANNED ENERGY INCREASES ON DEEP-LEVEL MINES F.J.L. Matthee, K. Nell and J.H. Marais	363
57	INTEGRATIVE ENGINEERING FRAMEWORK FOR A RESEARCH AND DEVELOPMENT ENTERPRISE L. Erasmus, M. Auret and C. Venter	376





Ref	Paper Title & Authors	Page
58	NOVEL USE OF SIMULATIONS TO RECONFIGURE CENTRIFUGAL PUMPING SYSTEMS IN REVERSE OPERATION TO GENERATE ELECTRICITY S.W. Hancock, J.A. Jacobs, J. van Laar and J. van Rensburg	386
59	INVESTIGATE AND IMPROVE HOW GRADUATE ATTRIBUTES ARE ASSESSED AT THE UNIVERSITY OF JOHANNESBURG - BENCHMARK AGAINST GLOBAL PRACTICES A.Baloyi , S.L. Gqibani, B.N. Mushwana, C. Anghel, H. Steenkamp and N.E. Nwobodo-Anyadiiegwu	406
60	EXPLORING DIFFERENT APPROACHES TO ASSESSING GRADUATE ATTRIBUTES THAT ARE PERCEIVED TO BE CHALLENGING H. Steenkamp, C. Anghel, N. Nwobodo-Anyadiiegwu, A. Baloyi, S.L. Gqibani and B.N. Mushwana	415
61	IDENTIFYING WATER WASTAGE IN DEEP-LEVEL MINES USING A SIMULATION-BASED ZERO-WASTE BASELINE M. le Roux, J.H. van Laar, R. Fair, and C.S.L. Schutte	429
62	AN ANALYSIS OF THE APPLICATION OF LEAN LIVE GAME AT A SOUTH AFRICAN HARNESS-MAKING COMPANY P. Machabaphala and F. Chiromo	442
63	A BUSINESS MODEL INNOVATION FRAMEWORK FOR SEIZING PRODUCT-SERVICE SYSTEMS F.J.V.E. van Zyl and C.S.L. Schutte	456
68	A ZERO-WASTAGE APPROACH TO BENCHMARK COMPRESSED AIR SYSTEMS ON PLATINUM MINES R.F. Marais, H.P.R. Joubert, J.F. van Rensburg and B. Pascoe	477
69	REINFORCEMENT LEARNING IN INVENTORY MANAGEMENT K.A. Manhanga and H. Steenkamp	492
72	EXPLORING ELECTRIC VEHICLES NUANCES ON INFRASTRUCTURE REQUIREMENTS AND SUSTAINABILITY IN SOUTH AFRICA M. Minnie and W. Maisiri	502
75	OPTIMISATION OF A FLEXIBLE MANUFACTURING SYSTEM THROUGH THE APPLICATION OF GREEDY KNAPSACK HEURISTIC M. Dewa	517
77	APPLICATION OF A3 METHODOLOGY TO IMPROVE BUSINESS PROCESSES AT XYZ LOGISTICS T. Mohono and K. Mokgohloa	526
86	ORDER PICKING'S SHORTEST PATH IDENTIFICATION USING ANT COLONY OPTIMIZATION ALGORITHM D. Tshiamala, L.K. Tartibu and R. Mutyavavire	535
87	A HOLISTIC FEASIBILITY ASSESSMENT OF THE SOUTH AFRICAN COAL-TO-CARBON INDUSTRY P. Mukodzani, T. Hattingh, M. Roopa, H. W. Neomagus and J. Bunt	550



Ref	Paper Title & Authors	Page
100	TEACHING 3IR COMPETENCIES TO TRANSITION TECHNOLOGISTS INTO 4IR PROFESSIONALS N. Mosia	563
101	CULTIVATING AMBIDEXTERITY IN INDUSTRIAL ENGINEERING TECHNOLOGY EDUCATION N. Mosia	575
102	ANALYSIS OF A SUSTAINABLE SME DEVELOPMENT PROGRAM: THE CASE OF ESD COMPANY L. G. Lamola and F. Chiromo	587
104	THE IMPACT OF COVID-19 INFECTIONS ON HEALTHCARE SERVICE DELIVERY IN SOUTH AFRICA N. Mosia	599
106	CONCEPTUALISING A LEARNING FARM: A CONTEXTUAL ADAPTION OF A LEARNING FACTORY FOR AGRICULTURE DEVELOPMENT O. Hougaard and T. Hattingh	611
111	USING A REGRESSION MODEL TO ASSESS LEADERSHIP STYLE ON THE LEVEL OF EMPLOYEE ENGAGEMENT AND JOB SATISFACTION H.M. Manthata and S. Naidoo	628
112	ASSESSING ORGANISATIONAL SUPPORT STRATEGIES TO REDUCE TURNOVER INTENTIONS AMONG HEALTHCARE WORKERS K. Kongo and S Naidoo	647
113	A SYSTEMIC APPROACH TO POTABLE WATER INFRASTRUCTURE MANAGEMENT IN RURAL SETTINGS - CASE STUDY MPUMALANGA PROVINCE M.E. Matlakala, D.V.V. Kallon and E.J. Ncube	664
114	A SYSTEMIC APPROACH TO POTABLE WATER INFRASTRUCTURE MANAGEMENT IN RURAL SETTINGS - CASE STUDY IN LIMPOPO PROVINCE M.E. Matlakala, D.V.V. Kallon and E.J. Ncube	675
116	SYSTEMS THINKING AND DECISION MAKING IN HIGHLY DYNAMIC AND COMPLEX ENVIRONMENTS M. Schleith, L. Pretorius and H. Steyn	683
118	AN INVESTIGATION INTO STOCK CAPACITY UTILIZATION OF A MANUFACTURING LINE AT A CATALYST MANUFACTURER J.J. Munilal, N. Ndivhuwo and K. Ramdass	699
123	BLOCKCHAIN SUITABILITY ASSESSMENT AND HIGH-LEVEL DESIGN: A SYSTEMATIC REVIEW S. Spencer-Hicken, C. Schutte and P.J. Vlok	718
124	BUSINESS PROCESS REENGINEERING CONCEPTUAL FRAMEWORK IN THE SOUTH AFRICAN MINING INDUSTRY S. Mchunu, L. Pretorius and J.H.C. Pretorius	736



Ref	Paper Title & Authors	Page
125	A REVIEW OF RENEWABLE ENERGY TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT: CASE STUDY-SOUTH AFRICA H. Kumba and O.A. Olanrewaju	752
126	CULTURAL DIFFERENCE AND IT PROJECT SUCCESS, A FALLACY OR REALITY ON THE SOUTH AFRICAN ICT SECTOR B. Javani, M. Thabe and M. Dewa	763
127	EFFECTIVE RISK MANAGEMENT PRACTICE AND PROJECT SUCCESS, THE CASE OF A WATER UTILITY'S CONSTRUCTION PROJECTS B. Javani, H.G. Mamena and M. Dewa	775
128	MAINTENANCE MANAGEMENT AND IMPACT ON ORGANISATIONAL PERFORMANCE, A POWER UTILITY PERSPECTIVE B. Javani, N. Jafta and M. Dewa	788
132	ASSESSING THE IMPACT OF LEAN MANUFACTURING PRACTICES ON OPERATIONS AT A SOUTH AFRICAN RAIL ORGANISATION: TOWARDS IMPROVING PERFORMANCE T. Tshamano and B. Sookdeo	802
133	EVALUATING THE EFFECTIVENESS OF LOGISTICS MANAGEMENT PRACTICES TO ENHANCE SERVICE DELIVERY AT A SOUTH AFRICAN PRINTING ORGANISATION J.B. Mtsweni and B. Sookdeo	817
134	HYBRID AND BEYOND: MULTI-METHODOLOGY SYSTEMS FOR IT PROJECT MANAGEMENT IN SA BANKING M.T.S. de Wet and C.S.L. Schutte	829
136	A CONCEPTUAL FRAMEWORK TO ANALYSE THE KEY SUCCESS FACTORS OF LOGISTICS SMES IN SOUTH AFRICA K. Desraj and B. Emwanu	850
138	A SYSTEMATIC LITERATURE REVIEW ON PRESCRIPTIVE ANALYTICS IN INDUSTRIAL ENGINEERING APPLICATION DOMAINS C. Du Plessis and C. Bisset	866
141	TOOL WEAR MONITORING AND PREDICTION IN MACHINING PROCESSES BY MEANS OF CONVOLUTIONAL NEURAL NETWORKS A.O. Adeodu , M.F. Ngwenya , R.W. Maladzi and M.G. Kanakana-Katumba	882
142	LEAN MANUFACTURING IN SPHEROIDISATION OF Ti6Al4V T.M. Dube; A.F. van der Merwe; S. Matope, H. Bissett and J. Postma	892
143	MAKING DECISIONS IN A COMPLEX WORLD - A SYSTEMS THINKING PERSPECTIVE N. Scribante and L. Pretorius	906
148	THE INFLUENCE OF THE 4TH INDUSTRIAL REVOLUTION ON GREEN ENTREPRENEURSHIP IN THE SOUTH AFRICAN CONTEXT: A SCOPING FRAMEWORK C.D. Diale, M.G. Kanakana-Katumba and H. Von der Ohe	920





Ref	Paper Title & Authors	Page
150	UTILIZATION OF ARTIFICIAL INTELLIGENCE IN OPTIMIZING PRODUCTION PROCESSES WITHIN THE GREEN ECONOMY: A LITERATURE REVIEW R.W. Maladzhi, C.D. Diale, M.G. Kanakana-Katumba, and H. Von der Ohe	934
151	OVERVIEW OF AGRICULTURAL WASTE MANAGEMENT PRACTICES IN NIGERIA O. Awogbemi and D.V.V. Kallon	947
152	INDUSTRIAL APPLICATION OF AGRICULTURAL WASTES O. Awogbemi and D.V.V. Kallon	962
162	STATE OF WASTEWATER INFRASTRUCTURE IN SOUTH AFRICA I. Mafanya and D.V.V. Kallon	979
167	TESTABILITY: AN IOT SYSTEM PERSPECTIVE J.E.W. Holm and J. van Deventer	986
168	A SYSTEMS PERSPECTIVE ON DATABASE MODELLING AND DESIGN P.W. Jordaan and J.E.W. Holm	1002
169	PHYSICAL SECURITY IN THE SOUTH AFRICAN BANKING SECTOR J.E.W. Holm and R. Crafford	1019
173	AN EMPIRICAL STUDY IN EXPLORING THE RELATIONSHIPS AMONG DESIGN THINKING TEAM DIVERSITY, TEAM INTEGRATION AND TEAM PERFORMANCE W. Botha and K.Y. Chan	1036
174	PRIORITISING BOILER MACHINE TRIPS USING A COST-DRIVEN PARETO CHART F.G. Choshi, O.A. Makinde and T.T. Munyai	1058
175	EXAMINING THE PROSPECTS AND CHALLENGES OF QUALITY IMPROVEMENT IN EDUCATION, RESEARCH, EXCHANGE, AND CAPACITY BUILDING L.J. Olaitan, A. Pradhan and N.I. Sukdeo	1067
176	A TECHNO-ENVIRONMENTAL AND ECONOMIC ASSESSMENT FOR PRODUCING 10 TONS/DAY OF BLENDED VERMICOMPOST AND COAL BASED FLY ASH BIO FERTILIZER A.E. Bobo, M.M. Manyuchi and N. Sukdeo	1078
177	IMPROVING MANUFACTURING PERFORMANCE IN A PRINTING PUBLIC INSTITUTION: A SOUTH AFRICAN PERSPECTIVE E.P. Mtshali, N.K. Stephen and K. Ramdass	1096
179	EXPLORING REGULATION AND LEGISLATION - APPLICATION OF SELECTED NANOTECHNOLOGY INITIATIVES IN THE FOOD INDUSTRY: HUMAN HEALTH A. Sithole and S. Singh	1109
181	NANOTECHNOLOGY IN FOOD SAFETY AND THE FOOD PROCESSING INDUSTRY T. Naicker and S. Singh	1122





Ref	Paper Title & Authors	Page
182	APPLICATION OF LEAN PRINCIPLES IN RAILWAY MAINTENANCE M. Bhebhe and P.N. Zincume	1134

